

Project Manual

for

WFAC Black Box Addition

for the

ALAMO COLLEGES DISTRICT

Package 2

VOLUME 1 – Divisions 00 – 41

July 19, 2024

PBK Project No.: 230462

ISSUE FOR PERMIT



Architecture
Engineering
Planning
Technology
Facility Consulting

601 NW Loop 410, Suite 400
San Antonio, Texas 78216
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OWNER/PROJECT MANAGER

Alamo Colleges District
2222 N. Alamo St.
San Antonio, Texas 78215

SECTION 00 01 07 - SEALS PAGE

LANDSCAPE ARCHITECT (L)

COMPANY NAME: EDGELAND GROUP

Registered Landscape Architect: Jacob T. Galles, R.L.A. #3022.
Address: 601 NW Loop 410, Suite 400.
City, State ZIP: San Antonio, Texas 78216.
Telephone Number: 713-460-0988.

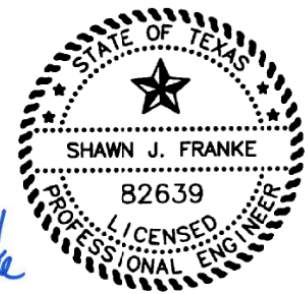


STRUCTURAL ENGINEER (S)

COMPANY NAME: LUNDY & FRANKE ENGINEERING, INC.

Texas Registered Engineering Firm F-3388.
Engineer of Record: Shawn J. Franke, P.E. #82639.
Address: 549 Heimer Rd.
City, State ZIP: San Antonio, Texas 78232.
Telephone Number: 210-979-7900.

Shawn Franke
7/19/2024



ARCHITECT (A)

COMPANY NAME: PBK ARCHITECTS, INC.

Texas Registered Firm BR-1608.
Registered Architect: Clifford Whittingstall, R.A. #18585.
Address: 601 NW Loop 410, Suite 400.
City, State ZIP: San Antonio, Texas 78216.
Telephone Number: 210-829-0123.



ROOFING / BUILDING ENVELOPE (R)

COMPANY NAME: BEAM PROFESSIONALS

Registered Roof Designer: Shawn LeCrone, IIBEC #0889.
Address: 601 NW Loop 410, Suite 400.
City, State ZIP: San Antonio, Texas 78216.
Telephone Number: 210-638-7240.



PBK Architects, Inc.
PBK Project No. 230462
Pkg 2 - Issue for Permit

WFAC Black Box Addition
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MECHANICAL ENGINEER (M)

COMPANY NAME: LEAF ENGINEERS.

Texas Registered Engineering Firm F-18672.
Engineer of Record: James R. Perron, P.E. #145042.
Address: 601 NW Loop 410, Suite 400.
City, State ZIP: San Antonio, Texas 78216.
Telephone Number: 210-638-7200.

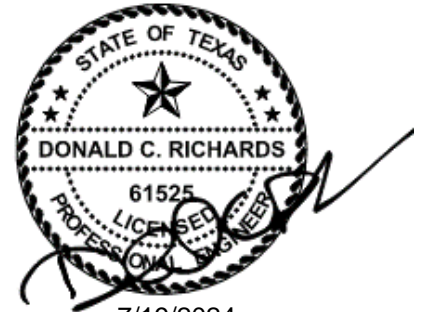


07/19/2024

ELECTRICAL, PLUMBING AND TECHNOLOGY ENGINEER (E P T)

COMPANY NAME: LEAF ENGINEERS

Texas Registered Engineering Firm F-18672.
Engineer of Record: Donald C. Richards, P.E. #61525.
Address: 610 NW Loop 410, Suite 400.
City, State ZIP: San Antonio, Texas 78216.
Telephone Number: 210-638-7200.



7/19/2024

THEATRICAL (TH)

COMPANY NAME: WJHW, INC

Theatrical Designer: Zach Thonen.
Address: 12175 Network Blvd, Suite 150.
City, State ZIP: San Antonio, Texas 78249.
Telephone Number: 210-561-9800.
No Seal Required

PBK Architects, Inc.
PBK Project No. 230462
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WFAC Black Box Addition
Alamo Colleges District
July 19, 2024

DOOR HARDWARE (H)

COMPANY NAME: ALLEGION, LLC

Product Representative: Marcus McElreath.

Address: 9330 Corporate Drive, Suite 806.

City, State ZIP: Selma, Texas 78154.

Telephone Number: 210-842-7709.

No Seal Required

END OF SECTION

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NOT USED

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NOT USED

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NOT USED

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NOT USED

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NOT USED

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NOT USED

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NOT USED

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NOT USED

DIVISION 46 - WATER AND WASTEWATER EQUIPMENT

NOT USED

DIVISION 48 ELECTRICAL POWER GENERATION

NOT USED

END OF SECTION

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SECTION 01 31 40 - SER: SHOP DRAWINGS/FIELD VISITS

PART 1 - GENERAL

1.1 SCOPE

- A This section defines and clarifies specific items of the Contract that are peculiar to the structural engineer's responsibilities. Refer to General Conditions for overall contractual agreements and to appropriate section of this specification for specifics on shop drawing, product data, and samples submitted.

PART 2 - GENERAL DEFINITIONS

2.1 STRUCTURAL ENGINEER OF RECORD

- A The engineer responsible for the design of the primary structural system and whose seal/signature appears on the contract structural drawings. Responsibility for any secondary structural and non-structural systems not shown on the structural drawings rests with the prime professional, the architect.

2.2 SPECIALTY ENGINEER

- A The engineer who is lawfully eligible to seal plans and designs for pre-engineered elements on systems which become part of the overall building.

2.3 GRADUATE ENGINEER

- A The engineer who is an Engineer-In-Training and working under the direct supervision of a Licensed Engineer.

2.4 SUBMITTALS

- A Items identified in the contract documents to be submitted by the contractor. Refer to individual sections of the specifications for specific items to be submitted.

2.5 FIELD OBSERVATIONS

- A Visits to the jobsite by the structural engineer-of-record or his authorized representative to ascertain whether the work is generally in accordance with the structural contract documents. These observations are not exhaustive nor continuous.

PART 3 - PROCEDURAL REQUIREMENTS

3.1 SHOP DRAWINGS

- A Refer to applicable section for specific requirements for number of copies to be submitted, time for review, etc. All submittals must come by way of the general contractor though the architect. Certain submittals, identified in specific sections of the specifications, generally regarding pre-engineered elements, will require a specialty engineer's seal and signature.

3.2 FIELD OBSERVATIONS

- A Structural engineer shall be notified at least 24 hours in advance of any concrete pour or other action that will cover up structural elements that have not been reviewed by the structural engineer. Refer to individual sections for specific stages of construction which require observation.

3.3 ENGINEER'S ACTIONS

- A SHOP DRAWINGS
 1. As per General or Special Conditions, the structural engineer will review shop drawings for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
 2. The structural engineer-of-record shall review the submittals and return them to the architect with one of the following statements checked off on the stamp:
 3. "NO exceptions Taken" informs the Architect that the structural engineer takes no exception to the submittal being approved as per and in accordance with AIA Document 201, section 4.2.7.
 4. "Make Corrections Noted" informs the Architect that the structural engineer has made corrections on the submittals but otherwise takes no exception to the submittal being approved as per and in accordance with AIA Document 201, section 4.2.7.
 5. "Revise and Resubmit" indicates important items must be corrected and resubmitted. Marks on the submittal may not necessarily cover all of the defects of the submittal. This action expresses the structural engineer's concern and his recommendation to the Architect that the submittal be reviewed and resubmitted as per and in accordance with AIA Document 201, section 4.2.7.
 6. "Return One Corrected Copy For File" informs the Architect that the submittal may be approved as per AIA Document 201, section 4.2.7, but a corrected copy showing that corrections have been acknowledged must be returned for the structural engineer's file.

3.4 SHOP DRAWINGS WITH SPECIALTY ENGINEER'S SEAL AND SIGNATURE

- A Certain shop drawings may be identified in specific sections of the specifications pertaining to pre-engineered structural elements specified by the structural engineer-of-record and designed by specialty engineers. The structural engineer shall verify that submittals have received prior approvals as required by the contract documents. Submittals shall bear the signature and professional seal of the specialty engineer responsible for the design as required by the contract documents. The structural engineer shall review the submittal for type, position, and connection to other elements within the primary structural system, and for criteria and loads used for their design. Action on these submittals will be the same as for other shop drawings.
 1. SHOP DRAWINGS FOR NON-STRUCTURAL ELEMENTS
 - a. Submittal of shop drawings covering items not shown or specified on structural plans by the Structural Engineer will be reviewed only to verify that the specialty engineer sealing the drawings/calculations has generally followed usual and customary application of code-mandated loads and design procedures. These submittals will be stamped "REVIEWED" indicating that the items listed interface with the primary structural framing without deleterious effect and no further action is taken.

3.5 SITE VISITS

- A The structural engineer-of-record ("SER") will make site visits at intervals appropriate to the stage of construction and as defined by the contract to visually observe the quality and the progress of the construction work relative to the primary structural system. The general contractor is responsible to notify the SER when structural elements are ready for review and prior to their being covered up. Failure to do so may result in key observations not being made, preventing the engineer from recommending acceptance of the work. A written report will be made of each visit listing discrepancies, if any, and describing what was observed. One copy will be given to contractor's representative at the jobsite, and one copy will be mailed to the Architect. If a follow-up visit is necessary it will be so noted on the report.
1. The SER shall not have control over or charge of and shall not be responsible for construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work for This Part of the Project, since these are solely the Contractor's responsibility under the Contract for Construction. The SER shall not be responsible for the Contractor's or a Subcontractor's schedule or failure to carry out the Work in accordance with the Contract Documents. The SER shall not have control over or charge of acts or omissions of the Contractor, Subcontractors, their agents or employees or other persons performing portions of the Work.

END OF SECTION

SECTION 01 56 39 - TREE PRUNING, FERTILIZING AND PROTECTION
PART 1 – GENERAL

- 1.1 RELATED DOCUMENTS:** The Drawings, Division 0 and Division 1 apply to the Work in this Section.
- 1.2 DESCRIPTION OF THE WORK:**
- A. Work Included:
 - Protecting of existing trees (Refer also to the drawings).
 - Protecting of existing utilities.
 - Protection fencing and planking
- 1.3 GENERAL PROVISIONS:**
- A. Trees and areas scheduled for work under this contract shall be identified in the field and indicated on plans and specifications where practical. Where this is not practical, work shall be directed in field by Owner's Representative.
 - B. Provision for access to the site for heavy equipment will be as directed by Owner's Representative. Equipment shall use prescribed temporary roadways and shall not be allowed in areas other than designated construction areas and designated roadways. Open grass areas which are altered or disturbed by equipment during the work shall be returned to pre-existing conditions at no additional cost to Owner.
 - C. Contractor shall protect root areas and crowns of trees from damage from construction operations and construction equipment. The Contractor shall repair such damage at no costs to Owner. Provide fences or other barricade where necessary for such protection.
 - D. Contractor shall modify exhaust pipes on construction equipment as needed to ensure that tree crowns are not damaged from exhaust heat from vertical exhaust pipes on top of construction equipment.
 - E. Equipment shall not contact tree trunks, limbs or foliage.
 - F. Contractor shall be responsible for providing all tree work/repair to any damage to existing trees during the contract period. Damage to any existing trees shall be reported immediately to the Owner's Representative. Contractor shall submit to Owner's Representative a written program of corrective pruning and tree care to repair damage with name of qualified forester or arboriculturist for Owner's approval.
- 1.4 REFERENCE STANDARDS:**
American National Standard for Tree Care Operations Arisi-A-300 Tree shrub and other woody plant maintenance-standard practices, 1995.
- 1.5 SUBMITTALS:**
Furnish required copies of manufacturers literature, samples, certifications, or laboratory analytical data for the following items:
Tree paint (manufacturer's literature)
- A. Urban forester or Arborist. (Resume with education, experience, and credentials)
 - B. Soil separator (manufacturer's literature and sample). For vapor barrier 10 mil visquene
 - C. Gravel (one cubic foot)
 - D. Mulch: Decomposed hardwood mulch: submit 1 cubic foot sample.
 - E. Fertilizer: submit product data.

PART 2 – PRODUCTS

- 2.1 TRENCHING MACHINE:** Shall be small non-riding track type trencher equal to Case 300.
- 2.2 SHARP SAND:** ASTM C-33 for fine aggregate.

- 2.3 **TREE PROTECTION FENCE POSTS:** 7' long metal t-posts.
- 2.4 **TREE PAINT:** Thompson Tree Seal, Cabot Tree Paint or approved equal.
- 2.5 **PRUNING TOOLS:** Shall be of good quality and working condition, sharp, and of the approved type for arboricultural work.
- 2.6 **WOOD FOR TREE PROTECTION PLANKING:** Shall be construction grade Southern Yellow Pine.
 - A. Wood for planking: two (2") x four (4")
- 2.6 **FENCING:** shall be orange plastic fencing 4' tall.
- 2.7 **INSECTICIDE:** Shall be Ortho "Lindane Borer and Leaf Miner Spray" by Ortho Consumer Products Division, Chevron Chemical Company, San Francisco, California 94119 or approved equal.
- 2.8 **FERTILIZER:** Arbor Green 30-10-7
- 2.9 **WATER:** Suitable for irrigation.

PART 3 – EXECUTION

- 3.1 **WORKMANSHIP:**
 - A. Work shall be performed by personnel trained and experienced in this work and shall be done under the direction of a qualified forester or arborist on Contractor's staff. Owner shall review and approve Contractor's program for repair to damaged trees prior to the work being done.
 - B. Work shall be performed in conformance with recognized horticultural and arboricultural practices. Where job requirements require deviation from normal practice, obtain approval.
- 3.2 **LIMB PRUNING:** ANSI-A-300 1995
- 3.3 **MAINTENANCE PRUNING:** Maintenance pruning is to maintain or improve tree health and structure and shall consist of the following: limited to branches measuring one (1") inch and larger.
 - A. Crown cleaning: Crown cleaning shall consist of the removal of the following items: dead, dying, diseased, weak branches from a tree's crown. Remove waterspouts from trunks and major limbs clearing up to a maximum distance of only six (6) feet to eight (8) feet from main trunk.
 - B. Crown thinning: Crown thinning shall consist of the selective removal of branches to increase light penetration, air movement, and reduce weight.
 - C. Crown raising: Crown raising shall consist of the removal of the lower branches of a tree in order to provide clearance. Clearance to be determined by Owner's representative.
 - D. All trees designated to remain and to be protected shall be pruned per ANSI-A-300 1995 standards.
 - 1. All cuts shall be made as close as possible to the trunk or parent limb, without cutting into the branch collar or leaving a protruding stub. Bark at the edge of all pruning cuts should remain firmly attached.
 - 2. All branches too large to support with one hand shall be pre-cut to avoid splitting or tearing of the bark. Where necessary, ropes or other equipment should be used to lower large branches or stubs into the ground.

3. Trimming shall not alter the natural appearance or result in leaving a hole in the canopy.
4. Paint wounds on Oak trees with approved paint.
5. Old injuries are to be inspected. Those not closing properly and where the callus growth is not already completely established should be bark traced if the bark appears loose or damaged. Such tracing shall not penetrate xylem (sapwood), and margins shall be kept rounded.
6. Equipment that will damage the bark and cambium layer should not be used on or in the tree. For example, the use of climbing spurs (hooks, irons) is not an acceptable work practice for pruning operations on live trees. Sharp tools shall be used so that clean cuts will be made at all times.
7. All cut limbs shall be removed from the crown upon completion of the pruning.
8. Trees susceptible to serious infectious diseases should not be pruned at the time of year during which the pathogens causing the diseases, or the insect vectors are most active. Similarly, if pruning wounds may attract harmful insects, pruning should be timed so as to avoid insect infestation.
9. Remove the weaker or less desirable of crossed or rubbing branches. Such removal, if possible, should not leave large open spaces in the general outline of the tree.
10. Where practical, all visible girdling roots shall be treated as follow: (1) Cut root at either end; or (2) Sever root in center with a chisel and allow growing tree to push root away; (3) Remove section of root.
11. The presence of any disease condition, fungus fruit bodies, decayed trunk or branches, split crotches or branches, cracks, or other structural weaknesses shall be reported in writing to a supervisor and/or the owner, and corrective measures recommended.

3.4 ROOT PRUNING: (in areas where roots cannot be preserved by hand digging)

- A. Root pruning shall be installed at the back of new curb for the parking lot excavation where the excavation for the lot lowers the grade below the existing grade within the drip line of the existing trees and in areas where soils will be lime stabilized.
- B. Root prune at edge of proposed excavation or lime stabilization only in areas where roots cannot be preserved.
- C. Root pruning by trenching shall be as required; twenty-four (24") inches deep and six (6") inches wide, or ten inches (10") below limits of proposed excavation, lime stabilization or soil disturbance, whichever is less.
- D. Trenching shall be performed by the approved trencher cutting any and all roots completely and cleanly. Tearing, shredding or pulling of the roots shall not be permitted. After trenching with machine, re-cut roots with pruning shears or saw to leave a smooth cut surface.
- E. Install 10 mil visquene in root prune trench to create non-leach barrier between soil stabilizer material and root zone.
- F. Fill trench to existing finished grade in a manner that will not allow soils to settle.
- G. Cover exposed roots within 24 hours using bank sand topsoil or mulch to prevent desiccation.

3.5 FENCES AND BARRICADES:

- A. Fences and/or barricades shall be installed prior to the commencement of any site preparation work (cleaning, grubbing or grading) placed where shown on the drawings or as herein described. Tree fencing shall be maintained throughout the construction project in order to prevent the following:
 1. Soil compaction in the root zone area resulting from vehicular traffic or storage of equipment and/or equipment and/or materials.

2. Root zone disturbances due to grade changes (greater than 3" inches cut or fill), and /or trenching not reviewed or authorized by the Owner's representative.
 3. Wounds to exposed roots, trunks, or limbs by mechanical equipment.
 4. Other activities detrimental to trees such as: chemical storage, cement truck wash-out and fires.
- B. In general, fences and barricades are intended to alert those working on the project that equipment and machinery are not to be stored or operated in the root zone. Where not shown, the fences shall be placed at the drip line. The exact location of fences shall be marked on site by Contractor and approved by Owner's Representative prior to construction of barricades.
- C. Posts shall be installed eight (8") feet O.C. maximum, one and one half (1 1/2') feet deep. Fence material pulled taut and secured with galvanized wire.

3.6 TREE PLANKING:

- A. Where exceptions result in temporary fence being closer than four feet to a tree trunk, protect trunk with strapped-on wood planking to a vertical height of 8 feet (or to the limits of the lower branches).
- B. Place two x fours with sides touching completely around the circumference of the tree. Secure at three points; top, middle and bottom with galvanized wire; twisted taut and stapled to wood planking.

3.7 TREE PROTECTION:

- A. All trees to be preserved on the property shall be protected against damage during construction operations by fencing as shown; subject to the approval of the Owner's Representative. The tree protection shall be installed prior to commencement of any site preparation work (clearing, grubbing or grading) and maintained in repair for the duration of the construction work unless otherwise directed. No material shall be stored or construction operation shall be carried on within a distance as shown of any tree to be saved or within the tree protection fencing. Tree protection shall remain until all work is completed.
1. Place 6" of mulch to completely cover the area underneath the drip line of the trees in areas where foot traffic cannot be avoided.
 2. Trees shall be watered once a week during periods of hot dry weather as directed by Owner's representative to thoroughly saturate soil.
 3. All grading within protected root zone areas shall be by hand or small equipment to prevent root damage resulting from soil compaction and rutting. Prior to grading relocate protective fencing to two feet behind grade change area.
- B. Any damage done to existing tree crowns or root systems shall be repaired immediately by an approved tree surgeon at the Owner's direction. Roots exposed and/or damaged during demolition and/or grading operations shall be cut off cleanly inside the exposed or damaged area, the cut surfaces painted with an approved tree paint, and the topsoil and mulch placed over the exposed root area immediately. The Owner shall have his representative present on the site to observe these operations.

3.8 CONSTRUCTION EQUIPMENT:

- A. Contractor shall modify construction equipment as necessary to ensure that exhaust systems do not burn or scorch tree crowns or branches. Vertical exhaust pipes shall be turned 90 degrees.
- B. Height of equipment and equipment operation heights shall be carefully monitored to ensure no damage to tree crowns or branching.

3.9 BORER PROTECTION: Immediately after tree protection is complete, apply specified insecticide at the rate prescribed by the manufacturer's instructions.

3.10 APPLICATION OF TREE FERTILIZER: Arbor Green 30-10-7 mixed and applied per product label instruction for 40 pounds of Arbor Green mixed in 100 gallons of water. Fertilizer shall be added to tank and mixed on site. Owner's representative shall be notified 24 hours prior to applying fertilizer.

3.11 ADDITIONAL PROVISIONS:

- A. No trash or warming fires shall be placed within twenty five (25') feet of the tree canopy.
- B. No pedestrian traffic shall occur within the drip line of any tree without proper protection measures in place.
- C. No soil shall be spread, under any tree within the drip line, unless otherwise designated or approved by owner's representative.
- D. Hand dig to preserve roots measuring one inch (1") in diameter and larger, roots shall not be scuffed or damaged otherwise.

END OF SECTION 01 56 39

SECTION 02 41 00 - DEMOLITION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes
 - 1. Salvage of building elements for reuse or return to Owner.
 - 2. Selective demolition of building elements for alteration purposes.

1.3 RELATED REQUIREMENTS

- A. Section 00 31 00 - Available Project Information: Existing building survey conducted by Owner; information about known hazardous materials.
- B. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- C. Section 01 10 00 - Summary: Sequencing and staging requirements.
- D. Section 01 10 00 - Summary: Description of items to be removed by Owner.
- E. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- F. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- G. Section 01 57 13 - Temporary Erosion and Sediment Control.
- H. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- I. Section 01 73 00 - Execution: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- J. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- K. Section 31 10 00 - Site Clearing: Vegetation and existing debris removal.
- L. Section 31 22 13 - Rough Grading: Topsoil removal.
- M. Section 31 22 13 - Rough Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- N. Section 31 23 23 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- O. Section 31 23 23 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.
- P. Section 32 93 00 - Plants: Relocation of existing trees, shrubs, and other plants.
- Q. Section 32 93 00 - Plants: Pruning of existing trees to remain.

1.4 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.

- B. Site Plan: Showing:
 - 1. Vegetation to be protected.
 - 2. Areas for temporary construction and field offices.
 - 3. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
 - 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
 - 2. Identify demolition firm and submit qualifications.
 - 3. Include a summary of safety procedures.

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
 - 1. Minimum of 5 years of documented experience.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 SCOPE

- A. As indicated on Drawings.

3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with other requirements specified in Section 01 73 00 - Execution.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Use of explosives is not permitted.
 - 3. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 4. Provide, erect, and maintain temporary barriers and security devices.
 - 5. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 6. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 7. Do not close or obstruct roadways or sidewalks without permit.
 - 8. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 - 9. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- C. Do not begin removal until receipt of notification to proceed from Owner.
- D. Do not begin removal until built elements to be salvaged or relocated have been removed.
- E. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.
- F. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- G. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

- H. If hazardous materials are discovered during removal operations, stop work and notify the Architect and the Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
 - 1. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.

3.3 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on Drawings.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction.
 - 2. Remove items indicated on Drawings.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and _____): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Refer to Section 01 10 00 for other limitations on outages and required notifications.
 - 4. Verify that abandoned services serve only abandoned facilities before removal.
 - 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

3.4 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 74 19 - Construction Waste Management and Disposal.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

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SECTION 02 41 16 - STRUCTURAL DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A Selective demolition of building elements for alteration purposes.

1.2 RELATED REQUIREMENTS

- A Section 00 31 00 - Available Project Information: Existing building survey conducted by Owner; information about known hazardous materials.
- B Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- C Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- D Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- E Section 01 57 13 - Temporary Erosion and Sediment Control.
- F Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- G Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- H Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

1.3 REFERENCE STANDARDS

- A 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2019.

1.4 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Site Plan: Showing:
 - 1. Areas for temporary construction and field offices.
 - 2. Areas for temporary and permanent placement of removed materials.
- C Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
 - 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
 - a. Shoring plan shall be prepared under the direct supervision of a professional engineer. Shop drawings shall be signed and sealed by Registered Professional Engineer.
 - 2. Identify demolition firm and submit qualifications.
- D Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.5 QUALITY ASSURANCE

- A Demolition Firm Qualifications: Company specializing in the type of work required.
 - 1. Minimum of 5 years of documented experience.

PART 2 PRODUCTS

2.1 MATERIALS

- A Fill Material: As specified in Section 31 23 23 - Fill.

PART 3 EXECUTION

3.1 SCOPE

- A Selective demolition of building elements for alteration purposes.
- B Within area of new construction, remove foundation walls and footings to a minimum of 2 feet below finished grade.
- C Outside area of new construction, remove foundation walls and footings to a minimum of 2 feet below finished grade.
- D Remove concrete slabs on grade within site boundaries.
- E Remove other items indicated, for salvage, relocation, and recycling.
- F Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill _____.

3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.
 - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 5. Provide, erect, and maintain temporary barriers and security devices.
 - 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 8. Do not close or obstruct roadways or sidewalks without permit.
 - 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 - 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B Do not begin removal until receipt of notification to proceed from Owner.
- C Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.

2. Prevent movement or settlement of adjacent structures.
 3. Stop work immediately if adjacent structures appear to be in danger.
- D Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E If hazardous materials are discovered during removal operations, stop work and notify Architect/Structural Engineer of Record and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

3.3 EXISTING UTILITIES

- A Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B Protect existing utilities to remain from damage.
- C Do not disrupt public utilities without permit from authority having jurisdiction.
- D Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.4 SELECTIVE DEMOLITION FOR ALTERATIONS

- A Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
1. Verify that construction and utility arrangements are as indicated.
 2. Report discrepancies to Architect/Structural Engineer of Record before disturbing existing installation.
 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.
- C Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 3. Verify that abandoned services serve only abandoned facilities before removal.
 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

- D Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

3.5 DEBRIS AND WASTE REMOVAL

- A Remove debris, junk, and trash from site.
- B Leave site in clean condition, ready for subsequent work.
- C Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

PBK Architects, Inc.
PBK Project No. 230462
Pkg 2 - Issue for Permit

WFAC Black Box Addition
Alamo Colleges District
July 19, 2024

SECTION 02 82 00 - ASBESTOS REMEDIATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Asbestos material abatement and disposal.
 - 2. Accessories necessary for complete removal.
- B. Related Sections:
 - 1. 01 35 43.13 - Environmental Procedures for Hazardous Materials

1.3 SUBMITTAL

- A. Submit copy of the signed waste manifests indicating the place, time and exact quantity of asbestos, received by an approved landfill.

1.4 QUALITY ASSURANCE

- A. Qualifications: Entity having minimum five (5) years documented experience, holding required current licenses for the removal, transport, and disposal and related activities relative to the work, having the required personal protective equipment and respirators for abatement operations, with current liability insurance, and who employs workers fully trained and knowledgeable in the removal of hazardous materials.
- B. Stop Asbestos Removal
 - 1. If a verbal or written Stop Asbestos Removal Order is given, immediately stop asbestos removal and maintain HEPA filtered negative pressure air flow in the containment and adequately wet any exposed ACM.
 - 2. Do not resume asbestos removal activity until authorized to do so in writing.
 - 3. A stop asbestos removal order may be issued at any time it is determined that abatement conditions/activities are not within regulatory requirements or that an imminent hazard exists to human health or the environment.
 - 4. Work stoppage will continue until conditions have been corrected.

PART 2 MATERIALS

NOT USED

PART 3 EXECUTION

3.1 REMEDIATION

- A. The Owner has conducted an asbestos survey and has determined that asbestos may be present in areas where work will be performed. The survey is made available for review.
 - 1. As part of the work, Owner requires asbestos removal to be performed under the construction contract.
 - 2. Asbestos may be present in vinyl tile under architectural woodwork or covered by, but not encapsulated, carpet materials and other types of flooring.
 - 3. Asbestos may be present in the ductwork above the ceiling panels.
 - 4. If asbestos is found, stop work in the area and engage an asbestos removal firm to remediate the asbestos from the area. Do not resume work in the affected areas until the abatement is complete and authorization to proceed with work in the affected areas is given. Work in areas not affected by asbestos may continue.
- B. Assume responsibility and liability for compliance with applicable Federal, State, and Local regulations related to the asbestos abatement work.
 - 1. Provide and maintain training, accreditations, medical exams, medical records, personal protective equipment (PPE) including respiratory protection including respirator fit testing, as required by applicable Federal, State and Local regulations.

2. Post required notices prior to the commencement of the work.
 3. Restrict access to containment areas to authorized, trained, and protected personnel.
 4. Prepare and post an emergency plan in clean room and equipment room of the decontamination unit.
 5. Do not permit workers to eat, drink, smoke, chew gum or tobacco, or break the protection of the respiratory protection system in the work area.
- C. Entering and Exiting Procedures: Establish procedures for entering and exiting containment area. Provide personnel decontamination unit with disposable coveralls, head covers, and clean respirators. Provide shower room between personnel decontamination area and equipment room.
- D. Decontamination Procedures: Establish procedures for decontamination upon leaving containment are in accordance with federal and state regulations.
- E. Provide negative pressure filtration systems to complete exchange air 4 time per hour. Provide standby system in the event of a machine failure or emergency.
1. Continuously monitor and record the pressure differential between the work area and the building outside of the work area.
- F. Prepare the Affected Area: Remove furnishings and materials to the extent necessary to remediate the asbestos.
- G. Containment of Areas:
1. Provide a secure containment work area in accordance with federal and state regulations. Avoid damage to existing partitions and ceilings scheduled to remain to the extent possible.
 - a. Establish critical barriers over each opening into the work area.
 - b. Close out vents and air ducts to prevent particulates from entering the HVAC system.
- H. Debris:
1. Place contaminated debris in a designated location within the containment area.
 - a. Place debris in minimum 6 mil poly bags before removing from contaminated areas. Pass Clean or decontaminate bags and pass and pass through a double 6 mil flap doorway into another bag or fiber drum. Remove to disposal dumpster/gondola/vehicle. Do not permit unprotected personnel to come in contact with contaminated bags.
 - b. Remove and dispose of contaminated debris in compliance with local regulations.
- I. Testing: Perform required tests and inspections upon completion of the work. Collect air samples and analyze in accordance with regulations. Upon satisfactory conclusion of testing, remove critical barriers.
- J. After thorough decontamination, complete asbestos abatement work upon meeting the regulated area clearance criteria and fulfilling the following:
1. Remove equipment, materials, and debris from the project area.
 2. Package and dispose asbestos waste as required.
 3. Repair or replace all interior finishes damaged during the abatement work.
 4. Fulfill other project closeout requirements as specified elsewhere in this specification.

3.2 CERTIFICATE OF COMPLETION BY CONTRACTOR

- A. Submit a signed Certificate of Completion at the completion of the abatement and decontamination of the regulated area.

END OF SECTION

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SECTION 02 83 00 - LEAD REMEDIATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 - 1. Recognition of lead-based material and its definition.
 - 2. Federal and state requirement reference.
 - 3. Contractor's Liability.
 - 4. Contractor's Acknowledgment.
- B. Related Sections:
 - 1. Section 01 35 43.13 - Environmental Procedures for Hazardous Materials.
- C. Lead as a Health Hazard:
 - 1. Lead poisoning is recognized as a serious environmental health hazard facing children today. Even at low levels of exposure - much lower than previously believed - lead can impair the development of a child's central nervous system, causing learning disabilities and leading to serious behavioral problems. Lead enters the environment as tiny lead particles and lead dust disburse when paint chips or chalks peels or wears away over time, or is otherwise disturbed. Ingestion of lead dust is the most common pathway of childhood poisoning; lead dust gets on a child's hands and toys and then into a child's mouth through common hand-to-mouth activity. Exposures may result from construction or remodeling activities that disturb lead paint, from ordinary wear and tear of windows and doors, or from friction on other surfaces.
 - 2. Ordinary construction and renovation or repainting activities carried out without lead-safe work practices can disturb lead-based paint and create significant hazards. Improper removal practices, such as dry scraping, sanding, or water blasting painted surfaces, are likely to generate high volumes of lead dust.
 - 3. Because Contractor and their employees will be providing services for Owner, and because Contractor's work may disturb lead-containing building materials, Contractor is hereby notified of the potential presence of lead-containing materials located within certain buildings utilized by Owner. All buildings built prior to 1978 are presumed to contain some lead-based paint until sampling proves otherwise.
 - 4. Refer to "Asbestos and Lead-Based Paint Survey Report – Appendix A" in this Project manual.
 - 5. OSHA Regulations contain specific and detailed requirements imposed on contractors subject to that regulation. OSHA Regulations define construction work as "work for construction, alteration, and/or repair, including painting and decorating". It includes, but is not limited to, the following:
 - a. Demolition or salvage of structures where lead or materials containing lead are present.
 - b. Removal or encapsulation of materials containing lead.
 - c. New construction, alteration, repair, or renovation of structures, substrates, or portions thereof that contain lead, or materials containing lead.
 - d. Installation of products containing lead.
 - e. Lead contamination/emergency cleanup.
 - f. Transportation, disposal, storage, or containment of lead or materials containing lead on the site or location at which construction activities are performed.
 - g. Maintenance operations associated with the construction activities described in Section 01 78 23 - Operation and Maintenance Data, or within this Section.

6. The Contractor shall notify the Owner if any Work may result in the disturbance of lead-containing building materials. Any and all Work that may result in the disturbance of lead-containing building materials shall be coordinated through the Owner. A signed copy of this Certification shall be on file prior to beginning Work on the Project, along with all current insurance certificates.
- D. Renovation, Repair, and Painting Rule:
1. Toxic Substance Control Act Section 402(a):
 - a. EPA requires lead safe work practices to reduce exposure to lead hazards created by renovation, repair, and painting activities that disturb lead-based paint. Pursuant to the Renovation, Repair and Painting Rule (RRP), renovations in homes, childcare facilities, and schools built prior to 1978 must be conducted by certified renovations firms, using renovators with training by a EPA-accredited training provider, and fully and adequately complying with all applicable laws, rules, and regulations governing lead-based materials, including those rules and regulations appearing within title 40 of the Code of Federal Regulations as part 745 (40 CFR 745).
 - b. The RRP requirements apply to all contractors who disturb lead-based paint in a six (6) square foot or greater area indoors or a 20 square foot or greater area outdoors. If a Department of Public Health certified inspector or risk assessor determines that a structure constructed before 1978 is lead-free, the federal certification is not required for anyone working on that particular building.

1.3 SUBMITTAL

- A. Contractor's Acknowledgment (Refer to end of Section).
- B. Submit copy of the signed waste manifests indicating the place, time, and exact quantity of material received by an approved landfill.

1.4 CONTRACTOR'S LIABILITY

- A. If the Contractor fails to comply with any applicable laws, rules, or regulations, and that failure results in a site or worker contamination, Contractor will be held solely responsible for all costs involved in any required corrective actions, and shall defend, indemnify, and hold harmless the Owner, pursuant to the indemnification provisions of Contract, for all damages and other claims arising therefrom.
- B. If lead disturbance is anticipated in the Work, only persons with appropriate accreditation, registrations, licenses, and training shall conduct this Work.
- C. It shall be the responsibility of the Contractor to properly dispose of any and all waste products, including, but not limited to, paint chips, any collected residue, or any other visual material that may occur from the prepping of any painted surface. It will be the responsibility of Contractor to provide the proper disposal of any hazardous waste by a certified hazardous waste hauler. This company shall be registered with the Department of Transportation (DOT) and shall be able to issue a current manifest number upon transporting any hazardous material from any Project site.
- D. The Contractor shall provide the Owner with any sample results prior to beginning Work, during the Work, and after the completion of the Work. The Owner may request to examine, prior to the commencement of the Work, the lead training records of each employee of Contractor.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

THE CONTRACTOR HEREBY ACKNOWLEDGES UNDER PENALTY OF PERJURY THAT IT:

- Has received notification of potential lead-based materials on Owner's property;
- Is knowledgeable regarding and will comply with all applicable laws, rules, and regulations governing work with, and disposal of, lead.

UNDERSIGNED WARRANTS THAT THEY HAVE AUTHORITY TO SIGN ON BEHALF OF AND BIND THE CONTRACTOR. THE OWNER MAY REQUIRE PROOF OF SUCH AUTHORITY.

DATE:

PROPER NAME OF THE CONTRACTOR:

SIGNATURE:

PRINT NAME:

TITLE:

PROJECT/CONTRACT NO.: _____ **(PROJECT OR CONTRACT) BETWEEN THE OWNER AND** _____ **(CONTRACTOR OR BIDDER).**

THIS CERTIFICATION PROVIDES NOTICE TO THE CONTRACTOR THAT:

The Contractor's work may disturb lead-containing building materials.

The Contractor shall notify the Owner if any work may result in the disturbance of lead-containing building materials.

The Contractor shall comply with the Renovation, Repair, and Painting Rule, if lead-based paint is disturbed in a six (6) square-foot or greater area indoors or a 20-square-foot or greater area outdoors.

END OF SECTION

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SECTION 02 87 13 - MOLD REMEDIATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Removal and disposal of mold.
- B. Related Sections:
 - 1. Section 01 35 46 - Indoor Air Quality Procedures.
 - 2. Section 01 45 23 - Testing and Inspecting Services.
 - 3. Section 02 41 00 - Demolition.
 - 4. Section 02 82 00 - Asbestos Remediation.
- C. References:
 - 1. S. EPA "Mold Remediation in Schools and Commercial Buildings" 2. U.S. EPA "A Brief Guide to Mold, Moisture, and Your Home."

1.3 REFERENCE STANDARDS

- A. 29 CFR 1910.134 - Respiratory protection; Current Edition.
- B. 29 CFR 1910.1200 - Hazard Communication; current edition.

1.4 DEFINITIONS

- A. Use of trade specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- B. Refer to Section 01 42 16 - Definitions for the following Terms:
 - 1. Experienced.
 - 2. Field Quality Control Testing.
 - 3. Installer/Applicator/Erector.

1.5 SUBMITTALS

- A. List of all personnel to be involved in the work with their training and certifications.
 - 1. List of all products and procedures proposed for use in performance of the work.
 - 2. Test reports.
 - 3. Certificates.
 - 4. Preliminary Visual Assessment Reports.
 - a. Photographs.
 - b. Maps of areas needing remediation.
 - c. Approximate Square footage of each area needing remediation.
 - 5. Submit Product Data and Safety Data Sheets for all materials brought on the site to be used.
- B. Proposed Schedule
 - 1. Provide documentation for proposed schedule of work, include inspection and reasonable amount of time for settlement of materials and equipment.

1.6 QUALITY ASSURANCE

- A. Conform to all Federal, State, and Local regulations which govern the handling and disposal of mold materials.
- B. For areas requiring containment, Contractor shall provide warning signage in English and Spanish outside remediation areas. Include yellow caution tape and signage with large black letters:

1. Signage to read: "Warning DO NOT ENTER remediation work in progress".

PART 2 PRODUCT

NOT USED

PART 3 EXECUTION

3.1 ENVIRONMENTAL ASSESSMENT

- A. Provide thorough assessment of existing conditions prior to developing remediation plan. Contractor shall ensure that all applicable means necessary for a thorough evaluation have been utilized.
 1. Visual Inspection:
 - a. Extent of water damage and mold growth shall be visually assessed.
 - b. Ventilation systems shall be visually checked, particularly for damp filters, but also for damp conditions and overall cleanliness elsewhere in system.
 - 1) Ensure that blind and inaccessible areas are thoroughly inspected.
 - c. Acoustical ceiling panels, gypsum board (sheetrock, wallboard, etc.), cardboard, paper, and other cellulosic surfaces shall be given careful attention during a visual inspection.
 2. Moisture Measurement:
 - a. Measure moisture content of materials which are suspected to have been exposed to water but show no visual signs of staining or fungal growth.
 3. Bulk/Surface Sampling:
 - a. Bulk or surface sampling is not required to undertake remediation. Remediation of visually identified fungal contamination shall proceed without further evaluation.
 - b. Bulk or surface samples may need to be collected to identify specific fungal contaminants as part of a medical evaluation if occupants are experiencing symptoms which may be related to fungal exposure or to identify presence or absence of mold if a visual inspection is equivocal (e.g., discoloration, and staining).
 - c. A laboratory specializing in mycology shall be consulted for specific sampling and delivery instructions. An individual trained in appropriate sampling methodology shall perform bulk or surface sampling.
 - 1) Bulk samples shall be collected from visibly moldy surfaces by scraping or cutting materials with a clean tool into a clean plastic bag.
 - 2) Surface samples shall be collected by wiping a measured area with a sterile swab or by stripping the suspect surface.
 4. Air Monitoring:
 - a. Air sampling for fungi shall not be part of a routine assessment. Decisions about appropriate remediation strategies can usually be made on the basis of a visual inspection. In addition, air-sampling methods for some fungi are prone to false negative results and therefore cannot be used to definitively rule out contamination.
 - b. Air monitoring may be necessary if an individual(s) has been diagnosed with a disease that is or may be associated with a fungal exposure (e.g., pulmonary hemorrhage/hemosiderosis, and aspergillosis).
 - c. Air monitoring may be necessary if there is evidence from a visual inspection or bulk sampling that ventilation systems may be contaminated. The purpose of such air monitoring is to assess the extent of contamination throughout a building. It is preferable to conduct sampling while ventilation systems are operating.
 - d. Air monitoring may be necessary if presence of mold is suspected (e.g., musty odors) but cannot be identified by visual inspection or bulk sampling (e.g., mold growth behind walls).
 - 1) The purpose of such air monitoring is to determine the location and/or extent of contamination.

- e. If air monitoring is performed, for comparative purposes, outdoor air samples shall be collected concurrently at an air intake, if possible, and at a location representative of outdoor air. For additional information on air sampling, refer to the American Conference of Governmental Industrial Hygienists' document, "Bioaerosols: Assessment and Control."
- f. Personnel conducting the sampling shall be trained in proper air sampling methods for microbial contaminants. A laboratory specializing in mycology shall be consulted for specific sampling and shipping instructions.
- g. Analysis of Environmental Samples:
 - 1) Microscopic identification of the spores/colonies requires considerable expertise. These services are not routinely available from commercial laboratories. Documented quality control in the laboratories used for analysis of the bulk/surface and air samples is necessary. The American Industrial Hygiene Association (AIHA) offers accreditation to microbial laboratories (Environmental Microbiology Laboratory Accreditation Program (EMLAP)). Accredited laboratories must participate in quarterly proficiency testing (Environmental Microbiology Proficiency Analytical Testing Program (EMPAT)).
- h. Evaluation of bulk/surface and air sampling data shall be performed by an experienced health professional. The presence of few or trace amounts of fungal spores in bulk/surface sampling shall be considered background. Amounts greater than this or the presence of fungal fragments (e.g., hyphae, and conidiophores) may suggest fungal colonization, growth, and/or accumulation at or near the sampled location. Air samples shall be evaluated by means of comparison (i.e., indoors to outdoors) and by fungal type (e.g., genera, and species). In general, the levels and types of fungi found should be similar indoors (in non-problem buildings) as compared to the outdoor air. Differences in the levels or types of fungi found in air samples may indicate that moisture sources and resultant fungal growth may be problematic.

3.2 REMEDIATION GENERAL

- A. Presence of mold, water damage, or musty odors shall be addressed immediately. In all instances, any source(s) of water must be stopped and extent of water damage determined.
- B. Water damaged materials shall be dried and repaired.
- C. In all situations, the underlying cause of water accumulation must be rectified or fungal growth will recur. Any initial water infiltration shall be stopped and cleaned immediately. An immediate response (within 24 to 48 hours) and thorough clean up, drying, and/or removal of water damaged materials will prevent or limit mold growth.
- D. If the source of water is elevated humidity, relative humidity shall be maintained at levels below 60% to inhibit mold growth.
- E. Emphasis shall be on ensuring proper repairs of the building infrastructure, so that water damage and moisture buildup does not recur.
- F. Five different levels of abatement are described in this section (Below).
- G. Size of area impacted by fungal contamination primarily determines the type of remediation. The sizing levels below are based on professional judgment and practicality; currently there is not adequate data to relate the extent of contamination to frequency or severity of health effects. The goal of remediation is to remove or clean contaminated materials in a way that prevents the emission of fungi and dust contaminated with fungi from leaving a work area and entering an occupied or non-abatement area, while protecting the health of workers performing the abatement. The listed remediation methods were designed to achieve this goal, however, due to the general nature of these methods it is the responsibility of the people conducting remediation to ensure the methods enacted are adequate. The listed remediation methods are not meant to exclude other similarly effective methods. Any changes to the remediation

methods listed in these guidelines, however, shall be carefully considered prior to implementation.

- H. Non-porous (e.g., metals, glass, and hard plastics) and semi-porous (e.g., wood, and concrete) materials that are structurally sound and are visibly moldy can be cleaned and reused. Cleaning shall be done using a detergent solution. Porous materials such as acoustical ceiling panels, insulation, and gypsum board with more than a small area of contamination shall be removed and discarded. Porous materials (e.g., wallboard, and fabrics) that can be cleaned, can be reused, but should be discarded if possible. A professional restoration consultant shall be contacted when restoring porous materials with more than a small area of fungal contamination. All materials to be reused shall be dry and visibly free from mold. Routine inspections shall be conducted to confirm the effectiveness of remediation work.
- I. The use of gaseous, vapor-phase, or aerosolized biocides for remedial purposes is not recommended. The use of biocides in this manner can pose health concerns for people in occupied spaces of the building and for people returning to the treated space if used improperly. Furthermore, the effectiveness of these treatments is unproven and does not address the possible health concerns from the presence of the remaining non-viable mold. For additional information on the use of biocides for remedial purposes, refer to the American Conference of Governmental Industrial Hygienists' document, "Bioaerosols: Assessment and Control."
- J. Level I: Small Isolated Areas (10 sq. ft or less) - e.g., acoustical ceiling panels, small areas on walls.
 - 1. Remediation can be conducted by regular building maintenance staff. Such persons shall receive training on proper clean up methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).
 - 2. Respiratory protection (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection shall be worn.
 - 3. Work area shall be unoccupied. Vacating people from spaces adjacent to work area is not necessary but is recommended in the presence of infants (less than 12 months old), persons recovering from recent surgery, immune suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity, pneumonitis, and severe allergies).
 - 4. Containment of the work area is not necessary. Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.
 - 5. Contaminated materials that cannot be cleaned shall be removed from the building in a sealed plastic bag. There are no special requirements for the disposal of moldy materials.
 - 6. Work area and areas used by remedial workers for egress shall be cleaned with a damp cloth and/or mop and a detergent solution.
 - 7. All areas shall be left dry and visibly free from contamination and debris.
- K. Level II: Mid-Sized Isolated Areas (10 - 30 sq. ft.) - e.g., individual wallboard panels.
 - 1. Remediation can be conducted by regular building maintenance staff. Such persons shall receive training on proper clean up methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).
 - 2. Respiratory protection (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection shall be worn.
 - 3. Work area shall be unoccupied. Vacating people from spaces adjacent to the work area is not necessary but is recommended in the presence of infants (less than 12 months old), persons having undergone recent surgery, immune suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity, pneumonitis, and severe allergies).

4. Work area shall be covered with a plastic sheet(s) and sealed with tape before remediation, to contain dust/debris.
 5. Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.
 6. Contaminated materials that cannot be cleaned shall be removed from the building in sealed plastic bags. There are no special requirements for the disposal of moldy materials
 7. Work area and areas used by remedial workers for egress shall be HEPA vacuumed (a vacuum equipped with a High-Efficiency Particulate Air filter) and cleaned with a damp cloth and/or mop and a detergent solution.
 8. All areas shall be left dry and visibly free from contamination and debris.
- L. Level III: Large Isolated Areas (30 - 100 square feet) - e.g., several gypsum board panels.
1. A health and safety professional with experience performing microbial investigations shall be consulted prior to remediation activities to provide oversight for the project.
 2. The following procedures at a minimum are recommended:
 - a. Personnel trained in the handling of hazardous materials and equipped with respiratory protection, (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection shall be worn.
 - b. The work area and areas directly adjacent shall be covered with a plastic sheet(s) and taped before remediation, to contain dust/debris.
 - c. Seal ventilation ducts/grills in the work area and areas directly adjacent with plastic sheeting.
 - d. Work area and areas directly adjacent shall be unoccupied. Further vacating of people from spaces near work area is recommended in the presence of infants (less than 12 months old), persons having undergone recent surgery, immune suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity, pneumonitis, and severe allergies).
 - e. Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.
 - f. Contaminated materials that cannot be cleaned shall be removed from the building in sealed plastic bags. There are no special requirements for the disposal of moldy materials.
 - g. Work area and surrounding areas shall be HEPA vacuumed and cleaned with a damp cloth and/or mop and a detergent solution.
 - h. All areas shall be left dry and visibly free from contamination and debris.
 3. If abatement procedures are expected to generate significant amounts of dust (e.g., abrasive cleaning of contaminated surfaces, demolition of plaster walls) or the visible concentration of the fungi is heavy (blanket coverage as opposed to patchy), then it is recommended that the remediation procedures for Level IV are followed.
- M. Level IV: Extensive Contamination (greater than 100 contiguous square feet in an area)
1. A health and safety professional with experience performing microbial investigations shall be consulted prior to remediation activities to provide oversight for the project. The following procedures are recommended:
 - a. Personnel trained in the handling of hazardous materials equipped with:
 - 1) Full-face respirators with high efficiency particulate air (HEPA) cartridges.
 - 2) Disposable protective clothing covering both head and shoes.
 - 3) Gloves.
 - b. Containment of the affected area:
 - 1) Complete isolation of work area from occupied spaces using plastic sheeting sealed with duct tape (including ventilation ducts/grills, fixtures, and any other openings).

- 2) The use of an exhaust fan with a HEPA filter to generate negative pressurization.
 - 3) Airlocks and decontamination room.
 - c. Vacating people from spaces adjacent to the work area is not necessary but is recommended in the presence of infants (less than 12 months old), persons having undergone recent surgery, immune suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity, pneumonitis, and severe allergies).
 - d. Contaminated materials that cannot be cleaned shall be removed from the building in sealed plastic bags. The outside of the bags shall be cleaned with a damp cloth and a detergent solution or HEPA vacuumed in the decontamination chamber prior to their transport to uncontaminated areas of the building. There are no special requirements for the disposal of moldy materials.
 - e. The contained area and decontamination room shall be HEPA vacuumed and cleaned with a damp cloth and/or mop with a detergent solution and be visibly clean prior to the removal of isolation barriers.
 - f. Air monitoring shall be conducted prior to occupancy to determine if the area is fit to reoccupy.
- N. Level V: Remediation of HVAC Systems.
1. A Small Isolated Area of Contamination (<10 square feet) in the HVAC System 1) Remediation can be conducted by regular building maintenance staff. Such persons shall receive training on proper clean up methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).
 - a. Respiratory protection (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection shall be worn.
 - b. HVAC system shall be shut down prior to any remedial activities.
 - c. Work area shall be covered with a plastic sheet(s) and sealed with tape before remediation, to contain dust/debris.
 - d. Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.
 - e. Growth supporting materials that are contaminated, such as the paper on the insulation of interior lined ducts and filters, shall be removed. Other contaminated materials that cannot be cleaned shall be removed in sealed plastic bags. There are no special requirements for the disposal of moldy materials.
 - f. Work area and areas immediately surrounding the work area shall be HEPA vacuumed and cleaned with a damp cloth and/or mop and a detergent solution.
 - g. All areas shall be left dry and visibly free from contamination and debris.
 - h. HVAC manufacturers shall be consulted for biocides recommend for use in their systems.
 2. Areas of Contamination (>10 square feet) in HVAC System: A health and safety professional with experience performing microbial investigations shall be consulted prior to remediation activities to provide oversight for remediation projects involving more than a small isolated area in an HVAC system. The following procedures are recommended:
 - a. Personnel trained in the handling of hazardous materials equipped with:
 - 1) Respiratory protection (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended.
 - 2) Gloves and eye protection.
 - 3) Full-face respirators with HEPA cartridges and disposable protective clothing covering both head and shoes shall be worn if contamination is greater than 30 square feet.
 - b. HVAC system shall be shut down prior to any remedial activities.

- c. Containment of the affected area:
 - 1) Complete isolation of work area from the other areas of the HVAC system using plastic sheeting sealed with duct tape.
 - 2) Use exhaust fan with HEPA filter to generate negative pressurization.
 - 3) Airlocks and decontamination room if contamination is greater than 30 square feet.
 - d. Growth supporting materials that are contaminated, such as the paper on the insulation of interior lined ducts and filters, shall be removed. Other contaminated materials that cannot be cleaned should be removed in sealed plastic bags. When a decontamination chamber is present, the outside of the bags shall be cleaned with a damp cloth and a detergent solution or HEPA vacuumed prior to their transport to uncontaminated areas of the building. There are no special requirements for the disposal of moldy materials.
 - e. Contained area and decontamination room shall be HEPA vacuumed and cleaned with a damp cloth and/or mop and a detergent solution prior to the removal of isolation barriers.
 - f. All areas shall be left dry and visibly free from contamination and debris.
 - g. Air monitoring shall be conducted prior to re-occupancy with the HVAC system in operation to determine if the area(s) served by the system are fit to reoccupy.
 - h. HVAC manufacturers shall be consulted for biocides recommend for use.
3. Hazard Communication: When fungal growth requiring large-scale remediation is found, building owner, management, and/or employer shall notify occupants in affected area(s) of its presence. Notification shall include a description of the remedial measures to be taken and a timetable for completion. Group meetings held before and after remediation with full disclosure of plans and results can be an effective communication mechanism. Individuals with persistent health problems that appear to be related to bioaerosol exposure should see their physicians for a referral to practitioners who are trained in occupational/environmental medicine or related specialties and are knowledgeable about these types of exposures. Individuals seeking medical attention shall be provided with a copy of all inspection results and interpretation to give to their medical practitioners.

3.3 CLOSEOUT DOCUMENTATION

- A. Documents required at closeout of project:
 1. Daily logs.
 - a. Brief description of work activities.
 - b. Number of personnel on site.
 - c. Type of equipment used.
 - d. Type of Products Used.
 - e. List of any non-compliance noted, emergencies, stop work orders (with detailed explanations).
 - f. Photographic logs.
 - g. Report certifying remediation is complete.

END OF SECTION

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SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A Formwork for cast-in-place concrete, with shoring, bracing and anchorage.
- B Openings for other work.
- C Form accessories.
- D Form stripping.

1.2 RELATED REQUIREMENTS

- A Section 03 20 00 - Concrete Reinforcing.
- B Section 03 30 00 - Cast-in-Place Concrete.
- C Section 05 12 00 - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-in-place concrete.

1.3 REFERENCE STANDARDS

- A ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- B ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
- C ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- D ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- E ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2019, with Errata (2021).
- F ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- G COE CRD-C 572 - Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop; 1974.
- H PS 1 - Structural Plywood; 2019.

1.4 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.
- C Suspended One-way, Two-way and Removeable Panormwork Shop Drawings: Include calculations or selections from manufacturer's prescriptive design tables that indicate compliance with applicable building code and manufacturer's requirements.
 - 1. Include the design engineer's stamp or seal on each sheet of shop drawings.
- D Shop Drawings: Indicate layout of prefabricated forms, including beams, drops and proposed concrete pour breaks.

1.5 QUALITY ASSURANCE

- A Designer Qualifications: Design formwork under direct supervision of a Professional Structural Engineer experienced in design of concrete formwork and licensed in Texas.
- B Maintain one copy of each installation standard on site throughout the duration of concrete work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A Deliver prefabricated forms and installation instructions in manufacturer's packaging.
- B Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.

PART 2 PRODUCTS

2.1 FORMWORK - GENERAL

- A Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B Design and construct concrete that complies with design with respect to shape, lines, and dimensions.
- C Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.
- D Comply with relevant portions of ACI CODE-318, ACI PRC-347, and ACI SPEC-301.

2.2 WOOD FORM MATERIALS

- A Softwood Plywood: PS 1, B-B High Density Concrete Form Overlay, Class I.
- B Lumber: Yellow Pine or equal species; no. 2 grade; with grade stamp clearly visible.

2.3 REMOVABLE PREFABRICATED FORMS

- A Manufacturers:
 - 1. SureVoid Products, Inc: www.surevoid.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B Preformed Steel Forms: Minimum 16 gauge, 0.0598 inch thick, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
 - 1. Exposed concrete finish areas shall use New or Like New Preformed Steel Forms.
- C Pan Type: Steel, of size and profile indicated.
- D Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; 2 inches 2 inches thick.

2.4 FORMWORK ACCESSORIES

- A Form Ties: Removable Removable type, galvanized metal galvanized metal, fixed fixed length, cone type, cone type, with waterproofing washer, with waterproofing washer, free of defects that could leave holes larger than 1 inch 1 inch in concrete surface.
- B Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete

and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.

1. Do not use materials containing diesel oil or petroleum-based compounds.
2. Products:
 - a. SpecChem, LLC; Bio Strip WB (water-based): www.specchemllc.com/#sle.
 - b. W. R. Meadows, Inc; Duogard II (water-based): www.wrmeadows.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- C Form Release Agent: Colorless mineral oil that will not stain concrete.
- D Filler Strips for Chamfered Corners: Wood strip type; 3/4 x 3/4 inch size; maximum possible lengths.
- E Dovetail Anchor Slot: Galvanized steel, at least 22 gauge, 0.0299 inch thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- F Flashing Reglets: Galvanized steel, at least 22 gauge, 0.0299 inch thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- G Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
- H Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05 12 00.
- I Waterstops: PVC, complying with COE CRD-C 572.
 1. All horizontal and vertical construction joints shall contain a rubber water stop.
 2. Configuration: As indicated on drawings.
 3. Size: As indicated on drawings. If not shown use 4" minimum bulb tee type.
 4. Manufacturers:
 - a. BoMetals, Inc: www.bometals.com/#sle.
 - b. Greenstreak: www.usa.sika.com/en/construction/concrete/concrete-accessories/waterstop-systems/pvc-waterstop/greenstreak-pvc-waterstop.html.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.2 EARTH FORMS

- A Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

3.3 ERECTION - FORMWORK

- A Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI SPEC-301.
- B Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D Align joints and make watertight. Keep form joints to a minimum.
- E Obtain approval before framing openings in structural members that are not indicated on drawings.

- F Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.
- G Coordinate this section with other sections of work that require attachment of components to formwork.
- H If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect/Structural Engineer of Record before proceeding.

3.4 APPLICATION - FORM RELEASE AGENT

- A Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.5 REMOVAL OF FORMS

- A Side forms of beams, walls and columns may be removed after cumulatively curing at not less than 50 degrees F (10 degrees C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.
- B Wall, beam, joist and slab soffits may be removed when all of the following conditions are satisfied:
 1. Strength of concrete as shown by standard cylinder test has reached at least 2,500 psi and at least 75% of specified design strength.
 2. Concrete has cured at least 7 days (4 days for type 3 cement) or additional time as required if during cold weather.
 3. Soffit forms shall not be removed from members that are supporting any load such as construction materials or shoring for floor or roof above unless it can be determined that the member has sufficient strength to support such loading.

3.6 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A Provide formed openings where required for items to be embedded in passing through concrete work.
- B Locate and set in place items that will be cast directly into concrete.
- C Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D Position recessed anchor slots for brick veneer masonry anchors to spacing and intervals specified in Section 04 26 13.
- E Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- F Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are watertight.
- G Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- H Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.7 FORM CLEANING

- A Clean forms as erection proceeds, to remove foreign matter within forms.
- B Clean formed cavities of debris prior to placing concrete.
 - 1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
 - 2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.8 FORMWORK TOLERANCES

- A Construct formwork to maintain tolerances required by ACI SPEC-117, unless otherwise indicated.
- B Construct and align formwork for elevator hoistway in accordance with ASME A17.1.
- C Camber slabs and beams 1/4 inch per 10 feet.

3.9 FORMWORK FINISH

- A Construct formwork in accordance with ACI 347, unless otherwise indicated.
- B Refer to architectural drawings for exposure of formed surfaces.
 - 1. The following defines class of finish:
 - a. Class A - Surfaces prominently exposed to public view where appearance is of special importance, typically noted on architectural drawings as "exposed"
 - b. Class B - Coarse textured concrete formed surface intended to receive plaster, stucco or wainscoting.
 - c. Class C - General standard for permanently exposed surfaces where other finishes are not specified.
 - d. Class D - Minimal quality requirement for surfaces where roughness is not objectionable, usually applied where surface will be permanently concealed.

3.10 FIELD QUALITY CONTROL

- A An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.
- C Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.11 FORM REMOVAL

- A Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A Reinforcing steel for cast-in-place concrete.
- B Supports and accessories for steel reinforcement.

1.2 RELATED REQUIREMENTS

- A Section 03 10 00 - Concrete Forming and Accessories.
- B Section 03 30 00 - Cast-in-Place Concrete.
- C Section 04 20 00 - Unit Masonry: Reinforcement for masonry.

1.3 REFERENCE STANDARDS

- A ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- B ACI MNL-66 - ACI Detailing Manual; 2020.
- C ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- D ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.
- E ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement; 2019.
- F ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- G ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement; 2016.
- H ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
- I AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars; 2018, with Amendment (2020).
- J CRSI (DA4) - Manual of Standard Practice; 2018, with Errata (2019).
- K CRSI (P1) - Placing Reinforcing Bars, 10th Edition; 2019.

1.4 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Shop Drawings: Comply with requirements of ACI MNL-66 Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
- C The Contractor shall obtain completely detailed shop drawings showing placement plans, bar bending lists, etc. Include the specific location and size of all accessories, chairs and bar supports. The Contractor shall carefully check these drawings, then submit them to the Architect/Engineer. The Architect/Engineer may conduct limited spot checks aimed solely at determining general comprehension of the design intent, then return them to the Contractor. The Contractor shall then carefully recheck the shop drawings and approve them prior to fabrication.
 - 1. NOTE: Regardless of the fabricators standard policy or other industry standards of practice, all straight and bent bars shall be tagged with the member mark. If the fabricator

elects to use member marks other than those shown on the structural drawings, the members must also be labeled with the original engineer's member marks in addition to those of the fabricator.

- D The Engineer's spot check shall not relieve the Contractor from correcting, at his own expense, any items that may thereafter be found not to comply with the plans and specifications.
- E Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
- F Reports: Submit certified copies of mill test report of reinforcement materials analysis.

1.5 QUALITY ASSURANCE

- A Perform work of this section in accordance with ACI SPEC-301.

PART 2 PRODUCTS

2.1 REINFORCEMENT

- A ALL REINFORCING (Unless noted otherwise)
 - 1. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 - a. Plain billet-steel bars.
- B BEAM STIRRUPS and COLUMN TIES
 - 1. Reinforcing Steel: Deformed bars, ASTM A996/A996M Grade 40 (280), Type A.
- C Steel Welded Wire Reinforcement (WWR): Galvanized, deformed type; ASTM A1064/A1064M.
 - 1. Form: Flat Sheets.
 - 2. WWR Style: As indicated on drawings.
- D Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

2.2 RE-BAR SPLICING:

- A Coupler Systems: Mechanical devices for splicing reinforcing bars.
 - 1. Comply with ACI CODE-318 steel reinforcing design strength requirements for splices in tension and compression.
 - 2. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B Dowel Bar Splicer with Dowel-Ins: Mechanical devices for splicing reinforcing bars.
 - 1. Comply with ACI CODE-318 steel reinforcing design strength requirements for splices in tension and compression.
 - 2. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.3 FABRICATION

- A Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
- B Welding of reinforcement is not permitted.

- C Locate reinforcing splices not indicated on drawings at point of minimum stress.
 - 1. Review locations of splices with Architect/Structural Engineer of Record .

PART 3 EXECUTION

3.1 PLACEMENT

- A Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B Do not displace or damage vapor barrier.
- C Accommodate placement of formed openings.

3.2 FABRICATION

- A Reinforcing shall be fabricated in accordance with "Manual of Standard Building Code Requirements for Reinforced Concrete" (ACI 318), latest edition. The Contractor shall be responsible for obtaining properly fabricated reinforcing and placing it properly.
- B Reinforcing steel, at the time concrete is placed, shall be free from excessive rust, scale, dried concrete, or other coatings that will destroy or reduce bond, in the opinion of the Engineer.
- C Reinforcing steel shall be accurately shop bent and placed in position, securely tied or supported to prevent movement during placing of concrete. Field bends will not be permitted without prior approval from Engineer. Authorized field bends shall be performed cold; no heating is permitted. Spacer bars, supports and accessories are not scheduled but are to be furnished and placed as described under MATERIALS paragraph in this Section. Raising of reinforcement (including welded wire fabric) during the pour will not be permitted.

3.3 CONCRETE COVER

A SUSPENDED STRUCTURES

- 1. Unless detailed otherwise on plans, reinforcing bars shall have concrete cover as follows:
 - a. Beam Stirrups; top, bottom and sides, 1-1/2".
 - b. Column ties and spirals, 1-1/2".
 - c. Concrete joists and slabs, 3/4".
 - d. Spread or spot footings, 3".

B SLAB AND BEAMS ON FILL

- 1. Chair and/or block reinforcing securely in position with concrete cover as follows:
 - a. Beam stirrups; top, 1-1/2", bottom and sides 3".
 - b. Slab bars; 1-1/2" from top.
- 2. Support reinforcing steel on concrete blocks or bricks spaced at approximately 4'-0" o.c. in each direction.

3.4 SPLICES

- A Necessary splices not shown on drawings or otherwise noted shall be in accordance with ACI specifications for bar sizes up to #11 size, but not less than 40 bar diameters. Splices in bars larger than #11 shall be made with approved thermal or mechanical coupling devices. Welding wire fabric shall be lapped 1-1/2 meshes, with a minimum lap of 8". All lap splices shall be contact type secured with annealed tie wire.

3.5 SLAB OPENINGS

- A Unless shown otherwise, at slab openings of 12" or less, spread main reinforcing around opening. At slab openings greater than 12", provide 2 #4x4'-0" bottom placed diagonally at each corner. At sides of openings, provide one full bar for each bar cut at opening. No main bars shall be cut without Engineer's approval.

3.6 CONDUITS IN SLABS

- A Electrical and mechanical conduit in slabs or joists shall run under upper layer of reinforcing or wire mesh; provide a minimum of 1-1/2" clear between conduits and between conduit and parallel reinforcing. Do not "bundle" conduits. See CONCRETE FORMWORK Section for thickened slab required at large conduits.

3.7 BEAM INTERSECTIONS

- A Unless shown otherwise on plans, at corners, angle bends and at junction with other beams, provide four #7x6'-0" "corner bars" (3 ft. each leg) , 2 top and 2 bottom. For deep beams with scheduled intermediate bars, provide matching 80 diameter corner bars" of the same size. At "T" intersection, place all "corner bars" so that one leg is in outside face of outside beam.

3.8 WALL INTERSECTIONS

- A Unless shown otherwise, at corners, angle bends, and at junction with other walls, lap all horizontal bars in both faces 30 diameters or use matching 80 diameter "Corner Bars".

3.9 BEAM TO WALL CONNECTION

- A Unless shown otherwise, where beam abuts or frames into concrete wall, extend beam bars 30 diameters into wall, or use 60 diameter dowels or 60 diameter "corner bars" with 30 diameter embedment into both beam and wall; bar size and quantity shall match beam bars. See CONCRETE FORMWORK section for key seat at construction joint.

3.10 WALL ENDS

- A Unless shown otherwise, where walls stop, position two (2) of the wall vertical bars at the end of the wall; provided that vertical bars are #6 or larger. If wall vertical bars are smaller than #6, use 2 #6 at wall ends in lieu of wall vertical bars. Provide #4 U-bars (30 diameter laps) enclosing vertical bars at end faces, same spacing as horizontal bars.

3.11 OPENINGS IN CONCRETE WALLS

- A Unless shown otherwise, Add 2 #6 bars in each face over opening, extending 30 diameters beyond limits of opening, and add 2#5x5'-0" placed diagonally at each corner of opening. Provide #4 U-bars (30 diameter laps) at end faces for each bar (horizontal or vertical) interrupted by opening. U-bars shall enclose horizontal or vertical bars at opening.

3.12 WALL DOWELS

- A Unless shown otherwise, provide 60 diameter wall dowels from beam or footing to match the size and spacing of all vertical bars in wall above; extend 30 diameters into wall. At construction joints, either continue all vertical bars or provide for 30 diameter laps of all vertical bars into wall above.

3.13 COLUMN DOWELS

- A Unless shown otherwise, provide dowels from bottom of beams, piers, footings or walls to match the size and quantity of bars scheduled in column above; extend 30 diameters into column. At construction joints, extend all vertical bars 30 diameters into column above; offset bars on 1 to 6 slope to provide proper lapping of bars in column above. If offset exceeds 3", stop lower column bars and provide separate 60 diameter dowels as described under "COLUMN DOWELS" above. Use contact lap splices as shown in details at column schedule.

3.14 COLUMN REINFORCEMENT

- A Unless shown otherwise, provide scheduled ties along full length of vertical bars and dowels except that at soffit down into column below and above construction joints, start first tie at one half of scheduled tie spacing. Also, unless shown otherwise, include scheduled ties in areas of floor or roof framing members unless width of framing members exceeds width of column above by at least 2" on all four faces. Columns built into concrete walls shall be reinforced same as scheduled column. Two-piece ties shall be deformed bars only and minimum laps shall be 12" for No.3 bars; 15" for No. 4 bars. Terminate column vertical bars at an elevation of 3" below top of upper roof beam unless otherwise detailed; bars shall lap into upper roof beam at least 30 diameters; provide 90 degree bend at bar ends as required to accomplish this.

3.15 COLUMN PIER CAPS

- A At columns carried directly by footing piers, and/or other places indicated on plans, construct a transitional pier cap extending from pier to column to allow accurate dowel or anchor bolt setting. Extend footing shaft reinforcing including hooping, to within 3" of top of plinth and make double wrap at top. Column dowels are as scheduled for column above. If column dowels occur outside of pier shaft hooping, provide "U" shaped ties (sizes, number, and spacing as scheduled for column above) for all such dowels.

3.16 TOPPING REINFORCEMENT

- A Reinforcement (including welded wire fabric) shall be chaired to proper depth as shown on plans and sections. Raising of reinforcement during pour is not acceptable.
- B CONSTRUCTION JOINTS
- C Provide and locate as necessary in CAST-IN-PLACE CONCRETE Section.
- D All reinforcing shall continue through the joint.
- E Add extra reinforcing if so directed by Engineer.

3.17 FIELD QUALITY CONTROL

- A An independent testing agency, as specified in Section 01 40 00 - Quality Requirements, will inspect installed reinforcement for compliance with contract documents before concrete placement.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A Concrete building frame members.
- B Concrete for composite floor construction.
- C Elevated concrete slabs.
- D Floors and slabs on grade.
- E Concrete shear walls, elevator shaft walls, and foundation walls.
- F Joint devices associated with concrete work.
- G Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, flagpole bases, thrust blocks, and manholes.
- H Concrete curing.

1.2 RELATED REQUIREMENTS

- A Section 03 10 00 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B Section 03 20 00 - Concrete Reinforcing.
- C Section 03 35 11 - Concrete Floor Finishes: Densifiers, hardeners, applied coatings, and polishing.
- D Section 07 92 00 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

1.3 REFERENCE STANDARDS

- A ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements - 2021 Edition, July 15, 2021
- B ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- C ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
- D ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction; 2015.
- E ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- F ACI PRC-305 - Guide to Hot Weather Concreting; 2020.
- G ACI PRC-306 - Guide to Cold Weather Concreting; 2016.
- H ACI PRC-308 - Guide to External Curing of Concrete; 2016.
- I ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- J ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- K ASTM A497/A497M - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete; 2007.
- L ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.
- M ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2021.
- N ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2023.

- O ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens); 2021.
- P ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- Q ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- R ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- S ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.
- T ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).
- U ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2023, with Editorial Revision.
- V ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2017.
- W ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.
- X ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2021.
- Y ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- Z ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2018.
- AA ASTM D994/D994M - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type); 2011 (Reapproved 2022).
- BB ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2018.
- CC ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting; 2015.
- DD ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers; 2020.
- EE ASTM E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric); 2014.
- FF ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).
- GG COE CRD-C 513 - Handbook for Concrete and Cement Corps of Engineers Specifications for Rubber Waterstops; 1974.
- HH COE CRD-C 572 - Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop; 1974.
- II ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.
- NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
- JJ NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.4 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Mix Design: Submit mix design for each type of concrete proposed.
- C Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
- D Mix Design: Submit proposed concrete mix design.
 1. Indicate proposed mix design complies with requirements of ACI SPEC-301, Section 4 - Concrete Mixtures.
 2. Indicate proposed mix design complies with requirements of ACI CODE-318, Chapter 5 - Concrete Quality, Mixing and Placing.
- E Test Reports: Submit report for each test or series of tests specified.
- F Sustainable Design Submittal: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete cast in place, mix design(s) used showing the quantity of portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

1.5 QUALITY ASSURANCE

- A Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.
- B Follow recommendations of ACI PRC-305 when concreting during hot weather.
- C Follow recommendations of ACI PRC-306 when concreting during cold weather.

1.6 MOCK-UPS

- A Construct and erect mock-up panel for architectural concrete surfaces indicated to receive special treatment or finish as result of formwork.
 1. Panel Size: Sufficient to illustrate full range of treatment.
 2. Panel Size: 6 by 6 feet.
 3. Number of Panels: Two.
- B If requested by Architect/Structural Engineer of Record , cast concrete against mock-up panel. Obtain acceptance of resulting surface finish prior to erecting formwork.

PART 2 PRODUCTS

2.1 FORMWORK

- A Comply with requirements of Section 03 10 00.

2.2 REINFORCEMENT MATERIALS

- A Comply with requirements of Section 03 20 00.

2.3 CONCRETE MATERIALS

- A Cement: ASTM C150, Type I - Normal Portland type.
 1. Acquire cement for entire project from same source.
- B Cement: ASTM C150, Type II - Moderate Portland type.
 1. Acquire cement for entire project from same source.
- C Cement: ASTM C150, Type III - High Early Strength Portland type.
 1. Acquire cement for entire project from same source.
- D Cement: ASTM C150, Type V - Sulfate Resistant Portland type.
 1. Acquire cement for entire project from same source.

- E Blended Cement: ASTM C595, Type IL Portland type.
 - 1. Acquire cement for entire project from same source.
- F Fine and Coarse Aggregates: ASTM C33/C33M.
 - 1. Acquire aggregates for entire project from same source.
- G Fly Ash: ASTM C618, Class C or F.
 - 1. Fly Ash may not be combined in mix with Type IL Cement.
- H Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.4 ADMIXTURES

- A Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
- C High Range Water Reducing Admixture: ASTM C494/C494M Type F.
- D Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
- E Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
- F Accelerating Admixture: ASTM C494/C494M Type C.
- G Retarding Admixture: ASTM C494/C494M Type B.
- H Water Reducing Admixture: ASTM C494/C494M Type A.
- I Shrinkage Reducing Admixture:
 - 1. ASTM C494/C494M, Type S.
- J Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.
 - 1. Potable Water Contact Approval: National Science Foundation (NSF) certification for use on structures holding potable water, based on testing in accordance with NSF 61 and NSF 372
 - 2. Products:
 - a. Aquafin, Inc: www.aquafin.net/#sle.
 - b. Xypex Chemical Corporation; XYPEX Admix C-500: www.xypex.com/#sle.

2.5 ACCESSORY MATERIALS

- A Underslab Vapor Barrier (Slab on Grade):
 - 1. Materials
 - a. Sheet Retarder: Polyolefin film, 15 mil thick minimum; able to maintain water vapor permeance of 0.01 perms tested in accordance with mandatory conditioning tests per ASTM E1745, Section 7.1 (7.1.1-7.1.5) , tensile strength conforming with ASTM E1745 Class A and ACI 302.1R.
 - 2. MANUFACTURERS / PRODUCTS
 - a. Henry Company; Fortifiber Moistop Ultra: www.henry.com.
 - b. Reef Industries / Vaporguard; www.reefindustries.com
 - c. Stego Industries LLC / Stego Wrap Vapor Barrier; www.stegoindustries.com. (Basis of Design)
 - d. Reef Griffolyn "15 mil green" by Reef Industries
 - e. Substitutions: No substitutions.
- B Non-Shrink Cementitious Grout: Premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
 - 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.

3. Products containing aluminum powder are not permitted.
4. Flowable Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - b. Euclid Chemical Company; NS GROUT: www.euclidchemical.com/#sle.
 - c. W. R. Meadows, Inc; Speed-E-Roc: www.wrmeadows.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
5. Low-Slump, Dry Pack Products:
 - a. Euclid Chemical Company; DRY PACK GROUT: www.euclidchemical.com/#sle.
 - b. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - c. W. R. Meadows, Inc; PAC-IT: www.wrmeadows.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.6 BONDING AND JOINTING PRODUCTS

- A Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.
1. Products:
 - a. Euclid Chemical Company; AKKRO-7T: www.euclidchemical.com/#sle.
 - b. SpecChem, LLC; Strong Bond Acrylic Bonder: www.specchemllc.com/#sle.
 - c. W. R. Meadows, Inc; ACRY-LOK-: www.wrmeadows.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B Epoxy Bonding System:
1. Complying with ASTM C881/C881M and of Type required for specific application.
 2. Products:
 - a. Euclid Chemical Company; DURAL FAST SET LV: www.euclidchemical.com/#sle.
 - b. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - c. SpecChem, LLC; SpecPoxy 1000, SpecPoxy 2000, SpecPoxy 3000, or SpecPoxy 3000FS: www.specchemllc.com/#sle.
 - d. W. R. Meadows, Inc; Rezi-Weld Gel Paste, Rezi-Weld Gel Paste State, Rezi-Weld 1000: www.wrmeadows.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- C Waterproofing Admixture Slurry: Slurry coat of Portland cement, sand, and crystalline waterproofing additive, mixed with water in proportions recommended by manufacturer to achieve waterproofing at cold joints in concrete.
1. Products:
 - a. Aquafin, Inc: www.aquafin.net/#sle.
 - b. W. R. Meadows, Inc; ADI-CON CW Plus: www.wrmeadows.com/#sle.
 - c. Xypex Chemical Corporation; XYPEX Concentrate: www.xypex.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D Waterstops: Rubber, complying with COE CRD-C 513.
1. **All construction joints, pour breaks, etc. with soil on one side or other shall have a waterstop. All waterstops are not shown on drawings.**
 - a. Configuration: Ribbed with centerbulb
 - b. Size: 6".
 - c. Products:
 - 1) Greenstreak Model 705.
 - 2) Greenstreak Model 724 (for form saver).
 - 3) Greestreak Model 698 (for base seal)

- 4) Greenstreak Model 667 (for retrofit systems)
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- E Reglets: Formed steel sheet, galvanized, with temporary filler to prevent concrete intrusion during placement.
 - 1. Size: As indicated on drawings.
- F Joint Filler: Compressible asphalt mastic with felt facers, complying with ASTM D 994, thickness as indicated on drawings and full depth of slab less 1/2 inch.
- G Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches on center; ribbed steel stakes for setting.

2.7 CURING MATERIALS

- A Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
 - 1. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - b. Euclid Chemical Company ; www.euclidchemical.com/#sle.
 - c. SpecChem, LLC; SpecFilm Concentrate or SpecFilm: www.specchemllc.com/#sle.
 - d. W. R. Meadows, Inc ; Evapre or Evapre-RTU: www.wrmeadows.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- B Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
 - 1. Product dissipates within 4 to 6 weeks.
 - 2. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com.
 - b. Euclid Chemical Company; www.euclidchemical.com.
 - c. SpecChem, LLC; SpecRez: www.specchemllc.com.
 - d. W. R. Meadows, Inc; 1100-Clear: www.wrmeadows.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- C Curing Compound, Non-Dissipating: Liquid, membrane-forming, clear, nonyellowing acrylic; complying with ASTM C309.
 - 1. Vehicle: Water-based.
 - 2. Gloss: Low.
 - 3. Solids by Mass: 15 percent, minimum.
 - 4. VOC Content: OTC compliant.
 - 5. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - b. LATICRETE International, Inc; Dress & Seal WB: www.laticrete.com/#sle.
- D Moisture-Retaining Sheet: ASTM C171.
 - 1. Curing paper, regular.
 - 2. Polyethylene film, white opaque, minimum nominal thickness of 4 mil, 0.004 inch.
 - 3. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.
- E Polyethylene Film: ASTM D2103, 4 mil, 0.004 inch thick, clear.
- F Water: Potable, not detrimental to concrete.

2.8 CONCRETE MIX DESIGN

- A Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.
- B Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301.
 - 1. For trial mixtures method, employ independent testing agency acceptable to Architect/Structural Engineer of Record for preparing and reporting proposed mix designs.
- C Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.
- D Normal Weight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C 39/C 39M at 28 days: 3000 psi.
 - a. Fly Ash Content: Maximum 20 percent of cementitious materials by weight.
 - 1) Fly Ash is not allowed in Type IL Cement mix designs.
 - b. Cement Content: Minimum 470 lb per cubic yard.
 - c. Maximum Slump: 5 inches. +/- 1/2"
 - 1) Slump shall be increased to 8 inches for drilled footings by means of chemical admixtures.
 - d. Maximum Aggregate Size:
 - 1) SLAB AND BEAMS ON FILL
 - (a) Unless detailed otherwise on plans maximum aggregate size shall be as follows:
 - (1) Beams and slabs, 1".
- E Control Low Strength Material (Flowable Fill):
 - 1. Compressive Strength, when tested in accordance with ASTM C 39/C 39M at 28 days: 50 to 100 psi.
 - 2. Cement Content: Minimum 100 lb per cubic yard.
 - 3. Fly Ash Content: Minimum 300 lb per cubic yard.
 - 4. Sand Content: Minimum 2,600 lb per cubic yard.
 - 5. Added Water Minimum 500 lb per cubic yard.

2.9 MIXING

- A On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
- B Transit Mixers: Comply with ASTM C94/C94M.
- C Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.1 EXAMINATION

- A Verify lines, levels, and dimensions before proceeding with work of this section.
- B Verify condition of substrate and adjacent materials under provisions of Section 01 40 00 - Quality Requirements.

3.2 CONSTRUCTION JOINTS

- A Provide in monolithic concrete framing so that not more than 400 cubic yards is placed in one day and no side dimension of the section being concreted is greater than 150 feet. Larger areas shall be approved by the Engineer.
- B Locate so as not to impair the strength of the structure, and coordinate the location and details with the Architect/Engineer. Location shall generally be near the middle of the spans of slabs and beams with wood or steel-formed soffits. When soffits are formed with cardboard cartons, locate construction joint on centerline of pier.
- C Provisions shall be made for transfer of shear and other forces through the joint. Generally this shall consist of forming horizontal keyways at mid-depth, 1-1/2" deep X 1/3 of beam or slab depth and allowing all reinforcing to continue through the joint. Add extra reinforcing if so directed by Engineer.
- D Follow procedure for "Bonding new concrete to old", as described herein.
- E Provide waterstops at all construction joints with soil or water on one side or other.

3.3 PREPARATION

- A Formwork: Comply with requirements of ACI SPEC-301. Design and fabricate forms to support all applied loads until concrete is cured and for easy removal without damage to concrete.
- B Verify that forms are clean and free of rust before applying release agent.
- C Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- D Prepare existing concrete surfaces to be repaired according to ICRI 310.2R.
- E Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in accordance with bonding agent manufacturer's instructions.
 - 1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
 - 2. Use latex bonding agent only for non-load-bearing applications.
- F Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.
- G In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.4 INSTALLING VAPOR RETARDER

- A Install materials in accordance with manufacturer's instructions and ASTM E1643.
- B Install vapor retarder with long dimension in direction of pour.
- C Extend vapor retarder to the perimeter of the slab. If practicable, terminate it at approximately the level of finish grade or slightly below, otherwise (a) at a point acceptable to the structural engineer or (b) where obstructed by impediments, such as dowels, waterstops, or any other site conditions requiring early termination of the vapor retarder. At the point of termination, seal vapor retarder to the slab itself using Stego Crete Claw tape, per manufacturer's instructions.
- D Overlap vapor retarder 6 inches where jointing is required. Seal with manufacturer's tape.
- E Seal all penetrations (including pipes) per manufacturer's instructions.

- F Penetrations through the vapor barrier are prohibited except reinforcing steel and permanent
- G Repair damaged areas in accordance with manufacturer's requirements.
- H Contact the manufacturer's representative to coordinate a review of the vapor retarder installation either by digital review or in person.

3.5 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A Comply with requirements of ACI SPEC-301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- B Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.
- C Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.
- D Provide waterstop material at all joints below grade.

3.6 PLACING CONCRETE

- A Place concrete in accordance with ACI PRC-304.
- B Place concrete for floor slabs in accordance with ACI PRC-302.1.
- C Notify Architect/Structural Engineer of Record not less than 24 hours prior to commencement of placement operations.
- D Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- E Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.
- F Carbon Monoxide and Carbon Dioxide Exposure: General Contractor shall be responsible for monitoring interior concrete floor exposure to excessive exhaust gases containing carbon dioxide (CO₂) or carbon monoxide (CO) during delivery, placement and finishing of concrete and until concrete floor is protected by specified curing method.
 - 1. CO₂ levels shall not exceed 4,500 parts per million. CO levels shall not exceed 15 parts per million at concrete surface within 5 feet of any source of exhaust gases.
 - a. Levels shall be monitored utilizing appropriate meter from company similar to CEA Instruments, Inc., 16 Chestnut Street, Emerson, NJ 07630; Phone (201-967-5660);
 - 2. Unvented combustion heaters shall not be in operation during concrete placement.
 - 3. Limit combustion engine equipment inside building during concrete to only that equipment necessary to place and finish concrete.
 - 4. Only two concrete trucks shall be in building at any given time and under no circumstance shall there be any earth moving equipment, dump trucks, grading equipment, or any other motorized equipment in operation until after the interior concrete floor is placed and protected by specified curing method.

3.7 SLAB JOINTING

- A Locate joints as indicated on drawings or as submitted and approved by Architect/Engineer.
- B Provide waterstop material per paragraph above at all joints below grade and joints shown to have waterstop.
- C Anchor joint fillers and devices to prevent movement during concrete placement.
- D Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

- E Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.
- F Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.
- G Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.
- H Repair underslab vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.
- I Separate slabs on grade from vertical surfaces with joint filler.
- J Place joint filler in floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- K Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface. Conform to Section 07 90 05 for finish joint sealer requirements.
- L Install joint devices in accordance with manufacturer's instructions.
- M Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- N Apply sealants in joint devices in accordance with Section 07 90 05.
- O Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- P Place concrete continuously between predetermined expansion, control, and construction joints.
- Q Do not interrupt successive placement; do not permit cold joints to occur.

3.8 FLOOR FLATNESS AND LEVELNESS

- A Flatness and levelness tolerances for floors shall conform to the requirements set forth in ACI 117, "Standard Tolerances for Concrete Construction and Materials", particularly section 4.5.6 and 4.5.7. Either of the following specifications is acceptable.
 - 1. Face Floor Profile Numbers (F-Numbers):
 - a. CONVENTIONAL, BULL-FLOATED; Flatness Ff = 15 Level FI = 13
 - b. CONVENTIONAL STRAIGHTEDGED; Flatness Ff = 20 Level FI = 15
 - c. FLAT; Flatness Ff = 30 Level FI = 20
 - d. VERY FLAT; Flatness Ff = 50 Level FI = 30
 - 2. 10-ft. Straightedge Method:
 - a. CONVENTIONAL, BULL-FLOATED; 1/2 in.
 - b. CONVENTIONAL, STRAIGHTEDGED; 5/16 in.
 - c. FLAT; 3/16 in.
 - d. VERY FLAT; 1/8 in.
- B Unless noted otherwise, slab surfaces shall conform to the following criteria:
 - 1. Offices, classrooms, corridors, etc: FLAT.
 - 2. Slabs (permanent or temporary) to be used as casting beds for job cast tilt walls. VERY FLAT
 - 3. Warehouses, storerooms, equipment rooms: STRAIGHTEDGED.
 - 4. Sidewalks, plazas, pavement: BULL-FLOATED.
 - 5. Gymnasium Floors: VERY FLAT
- C Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local

values for each measured section.

- D Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than $F(F) 13/F(L) 10$.

3.9 SEPARATE FLOOR TOPPINGS

- A Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.
- B Place required dividers, edge strips, reinforcing, and other items to be cast in.
- C Apply bonding agent to substrate in accordance with manufacturer's instructions.
- D Place concrete floor toppings to required lines and levels.
 - 1. Place topping in checkerboard panels not to exceed 20 feet in either direction.

3.10 CONCRETE FINISHING

- A Repair surface defects, including tie holes, immediately after removing formwork.
- B Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
 - 1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
- D Concrete Slabs: Finish to requirements of ACI PRC-302.1 and as follows:
 - 1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI PRC-302.1; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
 - 2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI PRC-302.1; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
 - 3. Other Surfaces to Be Left Exposed: Trowel as described in ACI PRC-302.1, minimizing burnish marks and other appearance defects.
 - a. Chemical Hardener: See Section 03 35 11.
- E In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

3.11 CURING AND PROTECTION

- A Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
 - 1. Normal concrete: Not less than seven days.
 - 2. High early strength concrete: Not less than four days.
- C Formed Surfaces: Cure by moist curing with forms in place for full curing period.
- D Surfaces Not in Contact with Forms:
 - 1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
 - a. Spraying: Spray water over floor slab areas and maintain wet.

- or
- b. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
- 2. Final Curing: Begin after initial curing but before surface is dry.
 - a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.
 - or
 - b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.12 FIELD QUALITY CONTROL

- A An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B Provide free access to concrete operations at project site and cooperate with appointed firm.
- C Concrete testing shall be at point of discharge. If concrete is pumped concrete shall be tested at the end of the discharge hose. If deposited directly from truck test may be made at truck.
- D Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- E Compressive Strength Tests: ASTM C 39/C 39M. For each test, mold and cure four concrete test cylinders. Obtain test samples for every 80 cu yd or less of each class of concrete placed each day with a minimum of 50 cu yd between each test.
- F Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M. Slump test shall be at point of discharge.

3.13 DEFECTIVE CONCRETE

- A Test Results: The testing agency shall report test results in writing to Architect/Structural Engineer of Record and Contractor within 24 hours of test.
- B Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- C Repair or replacement of defective concrete will be determined by the Architect/Structural Engineer of Record. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Structural Engineer of Record for each individual area.

3.14 PROTECTION

- A Do not permit traffic over unprotected concrete floor surface until fully cured.

3.15 BELOW STRENGTH CONCRETE

- A If the 28-day cylinder strengths fall below the specified strength, the concrete represented by such test cylinders shall be considered unacceptable and subject to removal. Consideration will be given to the acceptance of such concrete if it can be demonstrated to the satisfaction of the Engineer that the cylinder tests do not accurately represent the strength of the concrete in place, or that the structure is fully capable of carrying the loads for which it was designed. This data may be obtained by a series of non-destructive tests and core tests in accordance with ASTM C-42 of the concrete in place, and/or by load testing in accordance with applicable codes. All costs in connection with this additional testing and/or removal and replacement of defective concrete shall be paid by the Contractor.

END OF SECTION

SECTION 03 35 00 - CONCRETE FINISHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Clear coatings.
- B. Related Sections
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.
 - 2. Section 03 30 00 - Cast-in-Place Concrete: Curing compounds that also function as sealers.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with concrete floor placement and concrete floor curing.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Product Data: Manufacturer's published data and installation instructions for concrete polishing system and finishing products, including manufacturer's installation instructions, information on compatibility of different products, and limitations.
- D. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
- E. Warranty Documentation: Manufacturer warranty; ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Specimen Warranty: Manufacturer warranty.

1.5 QUALITY ASSURANCE

- A. For slabs indicated to receive concrete polishing system, do not proceed with concrete polishing unless manufacturer's representative and specialized equipment is present for every day of placement.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.7 FIELD CONDITIONS

- A. Maintain light level equivalent to a minimum 200 W light source at 8 feet (2.5 m) above the floor surface over each 20 foot (6 m) square area of floor being finished.
- B. Do not finish floors until interior heating system is operational.
- C. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.

1.8 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective work within a two-year period commencing on the Date of Substantial Completion.
- C. Manufacturer's Warranty: Provide two-year manufacturer warranty commencing on the Date of Substantial Completion.

- D. Installer's Warranty: Provide two-year manufacturer warranty commencing on the Date of Substantial Completion.

PART 2 PRODUCTS

2.1 CONCRETE FLOOR FINISH APPLICATIONS

- A. Typical Concrete Finishing:
1. Unless otherwise indicated, all exposed concrete floors are to be finished using high-gloss clear coating.

2.2 COATINGS

- A. High-Gloss Clear Coating: Transparent, non-yellowing, acrylic polymer-based coating.
1. Composition: Solvent-based.
a. Nonvolatile Content: 15 percent, minimum, when measured by volume.
b. Products:
1) Euclid Chemical Company: ULTRAGUARD: www.euclidchemical.com/#sle.
2) PROSOCO, Inc; LSGuard: www.prosoco.com/consolideck/#sle.
3) W. R. Meadows, Inc; Decra-Seal W/B: www.wrmeadows.com/#sle.
4) Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.2 GENERAL

- A. Apply materials in accordance with manufacturer's instructions.

3.3 COATING APPLICATION

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
C. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION

SECTION 03 35 10.1 – TOPCAST EXPOSED AGGREGATE CONCRETE

Part 1 – GENERAL

1.01 SUMMARY

- A. Section includes: **TOPCAST CONCRETE FINISH** produced through the use of a chemical surface retarder to expose the sand and fine aggregates of a concrete mix
- B. Related Sections: Refer to the following sections for related work

Section 02200: "Earthwork"

Section 03300: "Cast-In-Place Concrete"

Section 05500: "Metal Fabrications"

Section: 07900: "Joint Sealants"

1.02 REFERENCES

- A. American Concrete Institute (ACI)
- B. American Society for Testing and Materials (ASTM)
 - C 31 Practices for Making and Curing Concrete Test Specimens in the Field
 - C 33 Specification for Concrete Aggregates
 - C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - C 42 Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 - C 94 Specification for Ready-Mixed Concrete
 - C 143 Test Method for Slump of Hydraulic Cement Concrete
 - C 150 Specification for Portland Cement
 - C 172 Practice for Sampling Freshly Mixed Concrete
 - C 231 Test Method for Sampling Air Content of Freshly Mixed Concrete by Pressure Method
 - C 260 Specification for Air-Entraining Admixtures for Concrete
 - C 494 Specification for Chemical Admixtures for Concrete
 - D 994 Specification for Preformed Expansion Joint Filler for Concrete

1.03 SUBMITTALS

- A. General: Submit the following items in accordance with the Conditions of Contract and Section 01330, "Submittal Procedures".
- B. Product Data: Submit product data for the following materials and items.
- C. Reinforcement
- D. Forming Accessories
- E. Admixtures
- F. Chemical Surface Retarders
- G. Patching Compounds
- H. Sealants
- I. Shop Drawings" Submit detailed drawings for fabrication, bending and placement of concrete reinforcement.
- J. Show bar schedules, stirrup spacing, diagrams of bent bars and arrangement of reinforcement including bar overlap.
- K. Include special reinforcement required for openings through concrete slabs or structures.
- L. Laboratory Test Reports: Submit concrete test materials test reports and mix design reports certifying that each material or item complies with or exceeds the specified requirements.

1.04 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following, except as otherwise indicated:
 - 1. ACI 301 " Specifications for Structural Concrete for Buildings "
 - 2. ACI 304 " Guide for Measuring, Mixing, Transporting and Placing Concrete "
 - 3. ACI 305 " Hot Weather Concreting "
 - 4. ACI 306 " Cold Weather Concreting "
 - 5. ACI 308 " Standard Practice for Curing Concrete "
 - 6. ACI 309 " Standard Practice for Consolidation of Concrete "
 - 7. ACI 318 " Building Code Requirements for Reinforced Concrete "
 - 8. ACI 347 " Recommended Practice for Concrete Formwork "
 - 9. CRSI " Manual of Standard Practice "
 - 10. SP-66 " ACI Detailing Manual "
- B. Mock-up Panels: Prepare one mock-up panel at the project site to demonstrate proficiency of the contractor as well as determine the best procedures and degree of sand or aggregate exposure. Mock-up panels shall be a minimum of 6' x 10'. Contractor shall use the methods and materials proposed for use on the final installation. Uniformity in appearance of each panel shall be the responsibility of the contractor. The approved mock-up panel shall serve as a standard of appearance for the final work to be produced.
- C. Quality Control Testing During Construction: Contractor will engage independent concrete testing service for quality control during concrete construction operations.
 - 1. Notify owner's representative at least two (2) working days in advance of field operations requiring concrete testing, or of resumption of operations after stoppages.
 - 2. Coordinate concreting operations with testing service to facilitate quality control testing.
 - 3. Sample and test concrete during placement as follows:
 - a. Sampling Fresh Concrete: ASTM C172: except modified for slump to conform with ASTM C94
 - b. Slump: ASTM C143; test one for each concrete load at point of discharge and one for each set of compressive strength test specimens.
 - c. Air Content ASTM C231: pressure method: one for each set of compressive specimens.

- d. Compressive Strength Tests: ASTM C39; one (1) set for each 150 cubic yards (115 cubic meters) or fractions thereof, of concrete class placed in any one day or for each 5,000 sq. ft. (465 sq. meters) of surface area placed; two (2) specimens tested seven (7) days, three (3) specimens tested twenty eight (28) days and one (1) specimen retained in reserve for later testing if required.

Part 2 – PRODUCTS

2.01 FORM MATERIALS

- A. Unless otherwise indicated, construct formwork with plywood metal, metal-framed plywood or other acceptable materials to provide continuous, straight, smooth exposed surfaces.
 1. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bowing or deflection.
 2. Provide forms that comply with US Product Standard PS 1 when applicable
 - a. B-B High Density Overlaid Concrete Form, Class I
 - b. B-B (Concrete Form) Plywood Class I, Exterior Grade or better, edge sealed, with each piece bearing legible inspection trademark.
 3. Form Coatings: Provide commercially formulated form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - a. Acceptable Materials: "Form Seal 245" by Grace Construction Products. Customer Service Center 877-813-1710. www.graceconstructionproducts.com, or approved equal
 - b. Dayton Superior Clean Strip
 - c. Nox-Crete Form Coating
 4. Form Ties: where applicable Provide factory-fabricated, adjustable length, removable or snap off metal form ties, designed to prevent deflection and to prevent spalling concrete surfaces upon removal.

2.02 REINFORCING MATERIALS

- A. Cold-drawn steel wire. ASTM A82
- B. Welded wire fabric: ASTM A185, welded steel wire fabric, furnish in flat sheets, not rolls unless approved by the owners representative.
- C. Reinforcing Bars: ASTM A615, deformed.
 1. Provide Grade 40 bars as required in details.
 2. Provide Grade 60 Bars No.3-18, except as otherwise noted.
- D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place.
 1. Use wire type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, stone, broken block or pieces of concrete.
 2. For concrete-on-grade, use supports with sand plates or horizontal runners if base material will not adequately support chair legs.
 3. For exposed – to – view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs, which are protected with plastic, stainless

steel protected, or special stainless complying with CRSI Classes, C, D, or E, respectively.

- E. Shop fabricate the reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with ACI 315. In case of fabricating errors do not re-bend or straighten reinforcement in manner that will injure or weaken material.

2.03 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150 Types I-II and III, "Low-Alkali" cement unless otherwise specified. Use one brand of cement throughout the project unless otherwise approved by the owner's representative.
- B. Aggregates: Shall be gap- graded conforming to C 33, size to be approved by the owner's representative dependant upon the type, color and etch of exposure desired.
- C. Water: Potable, clean, fresh, free from oils, acids, organic matter or other deleterious substances.
- D. Admixtures: All admixtures shall be specified in the mix design.
 - 1. Air-Entraining Admixtures: ASTM C 260
 - 2. Water-Reducing Admixture: ASTM C 494, Type A.
 - 3. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
 - 4. Chloride-containing Admixtures are not permitted.

2.04 RELATED MATERIALS

- A. Expansion Joint Materials
 - 1. Typical Building: ASTM D 994, preformed strips of a bituminous mastic compositions
 - 2. Slabs – in Ground and Sidewalks: ASTM D 1751, preformed expansion joint filler having relatively little extrusion and substantial recovery after release from compression.
- B. Liquid Membrane – Forming Curing Compound: ASTM C 309, Type I or I-D, Class A.

2.05 CONCRETE MIX DESIGN

- A. General Top-Cast, " Ready Mixed " concrete unless otherwise approved or specified; in accordance with ASTM C 94. Exposed Aggregate Concrete should meet or exceed the following criteria.
 - 1. Compressive Strength: Minimum 3,000 psi strength at 28 days
 - 2. Concrete shall be gap-graded with weathered rounded coarse aggregate consisting of not more than 45% - 50% maximum content.
 - 3. Water/Cement Ratio: Not greater than .55 by weight.
 - 4. Slump: Not greater than 4 inches.
 - 5. Air Content: Between 4 ½% - 7 ½%
- B. Admixtures
 - 1. Use water-reducing admixtures in all concrete.
 - 2. Use air-entraining admixture in all exterior exposed concrete.

2.06 PLANT, EQUIPMENT, MACHINES AND TOOLS

- A. General: Plant, equipment, machines and tools used in the workplace shall be subject to approval and shall be maintained in a satisfactory working condition at all times.
 - 1. Provide equipment with capability of producing the required product, meeting or exceeding grade controls, thickness control and smoothness requirements as specified.
 - 2. Use of equipment shall be discontinued if it produces unsatisfactory results.
 - 3. Owner's representatives shall have access to the plant and all equipment to ensure proper operation and compliance with the specifications at all times during construction.

PART 3 EXECUTION

3.01 FORM SETTING

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure.
- B. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
- C. Design formwork to be readily removable without impact, shock or damage to cast - place - concrete surface and adjacent materials.
- D. Provisions for other trades: Provide openings in concrete formwork and slabs to accommodate other trades.
- E. Tolerances: set forms with the upper edge true to line and grade with an allowable tolerance of 1/4" (6mm) in any 10 foot (3 m) long section.

3.02 PLACING REINFORCEMENT

- A. Comply with CRSI's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports.
- B. Clean reinforcement of all loose rust and mill scale, earth, ice, oil, concrete splatter from previous pours and other materials, which reduce or destroy bond with concrete.
- C. Accurately position, support and secure reinforcement against displacement by formwork, construction or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
- D. Install welded wire fabric of same gage in as long of lengths as is practical. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps of adjacent widths to prevent continuous laps in either direction.

3.03 PREPARATIONS FOR PLACING CONCRETE

- A. Remove water from excavations. Before placement, remove wood chips, shavings, and hardened concrete etc. from forms.
 - 1. Clean all equipment.
 - 2. Wet forms, except in freezing weather, or oil properly with approved release.
- B. Earth shall be uniformly moist when concrete is placed. Sprinkling method shall not be such as to form mud or pools of water. Watering sub-grade immediately prior to concrete placement is not sufficient to make the soil uniformly moist.
- C. Notify other trades to permit installation of their work. Coordinate installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

3.04 PLACING CONCRETE

- A. Notify owner's representative 24 hours in advance prior to placement.
 - B. Filed Inspection: Do not place concrete until forms and reinforcing steel have been inspected and approved.
 - 1. Place Ready-Mix concrete within specified time after batching.
 - a. Below 40 degrees F (4 degrees C) See Cold Weather Placing
 - b. 40 – 85 degrees F (4-29 degrees C) 90 minutes
 - c. 86 – 90 degrees F (30-32 degrees C) 75 minutes
 - d. Above 90 degrees F (32 degrees C) 60 minutes
- * Concrete exceeding delivery times may be rejected by the owner's representative
- 2. Adding Water: Do not add water after initial introduction of mixing water for batch except when slump of concrete is less than specified upon jobsite arrival and the maximum water/cement ratio has not been exceeded.
 - a. Notify owner's representative prior to adding any additional water.
 - b. Add only water enough to bring concrete slump within the specified limits. Turn drum at least 30 additional revolutions at maximum mixing speed. Do not add water to batch at any later time.
 - c. Ensure that concrete strength meets or exceeds specified requirements, and water does not exceed maximum amount specified in the approved CONCRETE MIX DESIGN.
 - C. General: Comply with ACI 304, as specified herein.
 - 1. Place concrete continuously or in layers of such thickness that the concrete will not be placed on a preceding layer which has hardened sufficiently to cause formation of seams or planes of weakness.
 - 2. If section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practicable to its final location to avoid segregation.
 - D. Placing Concrete in Forms:
 - 1. Consolidate placed concrete by high frequency mechanical vibrating equipment, supplemented as necessary by hand spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations not further visible effectiveness of the machines being used. Generally 16-20" apart.
 - c. At each insertion, limit duration of vibration time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
 - E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in continuous operation, within the limits of construction joints, until placement of panel or section is completed. Maintain reinforcing in proper position during concrete placement operations
 - F. Placing Concrete Sidewalks: Place concrete in forms in one (1) layer of such thickness that when consolidated and finished, sidewalks will be of thickness indicated.

- G. Cold Weather Placing: Protect concrete work from physical damage or reduced strength caused by frost, freezing actions, or low temperatures, comply with ACI 306.
- H. Hot Weather Placing: When hot weather conditions exist that would seriously impair the quality and strength of concrete place concrete in accordance with ACI 305 and as herein specified.

3.05 CONCRETE FINISHING

- A. General: The use of a rolling tamper, jitterbug or rolling jitterbug shall be considered when producing micro etched concrete surfaces. This will enable the finisher to create a denser surface paste with no obstruction due to the appearance of coarse aggregate, allowing for a uniform sand texture.
 - 1. Protect all curbs, borders and adjacent concrete and masonry surfaces, pavers, stones etc. that are not to receive retarder finish prior to concrete placement and retarder application using **Grace "Face Off"**
 - 2. Place concrete in the manner prescribed previously. Screed or strike off the surface in two (2) directions using a wooden or metal straight edge to achieve the proper elevation in a sawing motion back and forth.
 - 3. Allow the bleed water to evaporate the surface. It can then be floated using a wooden hand float or a bull-float preferably wooden to close the surface and surround the coarse aggregate with cement paste. Float to a uniform appearance. Follow float operations with hand trowels or Fresno steel trowels to create tight dense smooth surface. (This may require two or three passes depending upon mix design and or desired finish to be achieved)

NOTE: Do not burnish the surface or allow the micro etched surface to prematurely dry prior to the application of Top Cast.

- B. Concrete Surface Retarders

Spray Applied, film forming top surface retarder, calibrated for specific sized aggregates and finish requirements without plastic covering. Color coded to allow for ease of application and verification of grade being used as well as even and complete coverage.

Acceptable Materials:

- 1. " **TOP CAST** " by Grace Construction Products. Customer Service Center, 877-813-1710, www.graceconstructionproducts.com
- 2. Bomanite Surface Deactivator (303) 369-1115 www.bomanite.com
- 3. Top-Cast Decorative Surface Retarder by Dayton (888) 977-9600 www.daytonsuperior.com

Spray Applied, film forming protective coating for adjacent masonry and concrete surfaces.

Acceptable Materials: " **FACE OFF** " by Grace Construction Products. Customer Service Center, 877-813-1710, www.graceconstructionproducts.com

1. Soon after the final seat finish has been completed spray **Grace “Top Cast”** surface retarder using a low-pressure sprayer with a 0.5gpm tip at a rate of 200—350 sq./ft. per gallon in a full hiding coat.
 - a. Once dry **Grace “ Top Cast “** will yield a coating that provides intermittent rain protection. Once completely dry it can be covered to protect the surface if heavy extended rains are predicted.

Retarder Selection Guide

Number / Aggregate Size to Expose / Color

03 / Acid Etch Finish / Lt. Blue Violet
05 / Sand Texture Finish / Lt. Blue
15 / up to ¼”agg. / Yellow
25 / 1/8” to ¼” agg / Beige
50 / 1/8” to 3/8” agg. / Canary Green
75 / ¼”-3/8” agg. / Blue
100 / 3/8” to ½” agg. / Gray
125 / 3/8” to 5/8” agg. / Pink
150 / 3/8” to 5/8” agg. / Green
200 / 5/8” to 1” agg. / Salmon
250 / 1” to 1 ½” agg. / Lt. Orange

4. Wash surface with water rinse using stiff brooms and water hose or by high pressure washing with power equipment as early as 4- 6 hours in very hot weather or the following day up to 24 hours. Retarder removal intervals are dependent upon strength of the concrete mix, aggregate size and desired washing techniques. Earlier washing on the light etches may be necessary. Verify in accordance with the mock-up approval detailed herein.
5. Rinse water and cement matrix removal shall be in accordance with local codes and should not be allowed to be washed or flow down to arroyos, storm sewers, ponds, streams or sanitary sewers by precipitation or other surface flows.
6. Prior to completion of the project, remove wash water residue from the site to location approved by the local district.

3.07 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Immediately cut out honeycomb, rock pockets and voids over ¼ inch (6mm) in any dimension as well as holes left by tie rods, bolts etc. down to solid concrete but, in no case to a depth less than 1 inch (25mm).
 1. Cut edges perpendicular to concrete surface.
 2. Thoroughly clean, dampen with water, and brush coat area to be patched with neat cement grout or proprietary bonding agent before placing cement mortar or proprietary patching compound.
- B. Remove and replace concrete with defective surfaces if defects cannot be repaired to the satisfaction of the owner’s representative.
 1. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface as well as stains and other discolorations that cannot be removed by cleaning.
 - a. Dampen concrete surfaces in contact with patching concrete and brush with neat cement grout or apply concrete bonding agent.

- b. Mix Patching concrete of same materials to provide concrete of same type of class as original concrete.
- c. Place, compact and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

END OF SECTION 03 35 10.1

SECTION 03 54 00 - CAST UNDERLAYMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
- B. Related Sections:
 - 1. Section 01 73 00 - Execution: Alteration project procedures; selective demolition for remodeling.

1.3 REFERENCE STANDARDS

- A. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
- B. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens); 2021.
- C. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- D. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2018.
- E. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars; 2021.
- F. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, environmental limitations, and installation instructions.
- C. Manufacturer's Instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F (41 degrees C).

1.6 FIELD CONDITIONS

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F (10 degrees C) 24 hours before, during and 72 hours after installation of underlayment.
- C. During the curing process, ventilate spaces to remove excess moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Specifications are based on products named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding

substitutions to be considered.

1. Gypsum-Based Underlayment:
 - a. ACG Materials; Accucrete: www.acgmaterials.com/#sle.
 - b. ARDEX Engineered Cements; ARDEX K 22 F with ARDEX P51 Primer: www.ardexamericas.com/#sle.
 - c. Dependable Chemical Co., Inc; ____: www.floorprep.com/#sle.
 - d. Dependable Floor Products; GSL 2.6K: www.floorprep.com/#sle.
 - e. Hacker Industries, Inc; Firm-Fill 2010+: www.hackerindustries.com/#sle.
 - f. Maxxon Corporation; Gyp-Crete 2000/3.2K: www.maxxon.com/#sle.
 - g. USG; Levelrock® Series 2500 Floor Underlayment: www.usg.com/#sle.
2. Cementitious Underlayment:
 - a. ARDEX Engineered Cements; ARDEX V 1200 with ARDEX P51 Primer: www.ardexamericas.com/#sle.
 - b. BASF Construction Chemicals; MBT Mastertop 110 Plus Underlayment.
 - c. Custom Building Products; CL-150 Self-Leveling Underlayment: www.custombuildingproducts.com/#sle.
 - d. Dayton Superior Corporation; ____: www.daytonsuperior.com/#sle.
 - e. Dependable Chemical Co., Inc; ____: www.floorprep.com/#sle.
 - f. Hacker Industries, Inc; True-Screed: www.hackerindustries.com/#sle.
 - g. H.B. Fuller Construction Products, Inc; TEC Level Set 200 Self-Leveling Underlayment with TEC Multipurpose Primer: www.tecspecialty.com/#sle.
 - h. H.B. Fuller Construction Products, Inc; TEC Level Set 500 HF Self-Leveling Underlayment with TEC Multipurpose Primer: www.tecspecialty.com/#sle.
 - i. Kaufman Products Inc; SureFlow 040: www.kaufmanproducts.net/#sle.
 - j. Koster American Corporation; ____: www.kosterusa.com/#sle.
 - k. LATICRETE International, Inc; LATICRETE DRYTEK Skimcoat with DRYTEK LEVELEX Primer: www.laticrete.com/#sle.
 - l. LATICRETE International, Inc; LATICRETE NXT Level Plus with NXT Primer: www.laticrete.com/#sle.
 - m. LATICRETE International, Inc; LATICRETE NXT Skim: www.laticrete.com/#sle.
 - n. LATICRETE International, Inc; LATICRETE SUPERCAP SC500 with LATICRETE SUPERCAP Primer Plus: www.laticretesupercap.com/#sle.
 - o. Loba-Wakol, LLC; WAKOL Z 501 Patching Compound: www.loba-wakol.com/#sle.
 - p. Mapei Corporation; Ultraplan 1.
 - q. Maxxon Corporation; Level-One EZ: www.maxxon.com/#sle.
 - r. Platform Performance Cements; Platform Cements - Platform L2: www.profloorprep.com/#sle.
 - s. The QUIKRETE Companies; ____: www.quikrete.com/#sle.
 - t. SILPRO Corporation; SilFlo 220: www.silpro.com/#sle.
 - u. Stauf USA LLC; SLC-540 Self Leveling Compound: www.staufusa.com/#sle.
 - v. UZIN UTZ NORTH AMERICA, INC; UZIN PE 260 primer with UZIN NC 170 LevelStar: us.uzin.com/#sle.
 - w. USG; Durock® Quik-Top Self-Leveling Underlayment: www.usg.com/#sle.
 - x. W. R. Meadows, Inc; Floor-Top STG: www.wrmeadows.com/#sle.
 - y. Texrite; Texrite Flowrite FS with Bonding Primer 500 :
3. Sound Control Mat:
 - a. ACG Materials; AccuQuiet D18: www.acgmaterials.com/#sle.
 - b. AcoustiGuard - WILREP LTD; ISO-SEP 25HD Rubber Isolation Pads: www.acoustiguard.com/#sle.
 - c. Hacker Industries, Inc; Firm-Fill SCM 125: www.hackerindustries.com/#sle.
 - d. Keene Building Products; Quiet Qurl 025 MT: www.keenebuilding.com/#sle.
 - e. Maxxon Corporation; Acousti-Mat 1/4: www.maxxon.com/#sle.

- f. Pliteq Inc; GenieMat FF: www.pliteq.com/#sle.
- g. USG; Levelrock® SAM-N25 Sound Attenuation Mat: www.usg.com/#sle.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 MATERIALS

A. Cast Underlayments, General:

B. Gypsum-Based Underlayment: Gypsum based mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:

1. Compressive Strength: Minimum 2500 pounds per square inch (17.24 MPa), tested per ASTM C472.
2. Density: Maximum ____ pounds per cubic foot (____ kg/cu m).
3. Final Set Time: 1 to 2 hours, maximum.
4. Thickness: 3/4 inch (19 mm) to maximum 3-1/2 inch (89 mm).
5. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.

C. Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's instructions will produce self-leveling underlayment with the following properties:

1. Compressive Strength: Minimum ____ pounds per square inch (____ MPa) after 28 days, tested per ASTM C109/C109M.
2. Flexural Strength: Minimum 1000 psi (6.9 MPa) after 28 days, tested per ASTM C348.
3. Density: 125 pounds per cubic foot (2002 kg/cu m), nominal.
4. Final Set Time: 1-1/2 to 2 hours, maximum.
5. Thickness: Capable of thicknesses from feather edge to maximum 3-1/2 inch (89 mm).
6. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.

D. Aggregate: Dry, well graded, washed silica aggregate, approximately 1/8 inch (3 mm) in size and acceptable to underlayment manufacturer.

E. Reinforcement: Galvanized metal lath complying with recommendations of underlayment manufacturer for specific project circumstances.

F. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to underlayment mix materials.

G. Primer: Manufacturer's recommended type.

H. Joint and Crack Filler: Latex based filler, as recommended by manufacturer.

I. Sound Control Mat: Sheet material, perimeter isolation strip, and tape; as recommended by the underlayment manufacturer.

2.3 MIXING

A. Site mix materials in accordance with manufacturer's instructions.

B. Add aggregate for areas where thickness will exceed 1/2 inch (12.7 mm). Mix underlayment and water for at least two minutes before adding aggregate, and continue mixing to assure that aggregate has been thoroughly coated.

C. Mix to self-leveling consistency without over-watering.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.

3.2 PREPARATION

- A. Concrete: Mechanically prepare steel troweled concrete to create a textured surface necessary to achieve the best bond; acceptable methods include bead blasting and scarifying. Do not use acid etching.
- B. Wood: Install metal lath for reinforcement of underlayment.
- C. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- D. Vacuum clean surfaces.
- E. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- F. Close floor openings.
- G. Install sound control mat in accordance with manufacturer's instructions.

3.3 APPLICATION

- A. Install underlayment in accordance with manufacturer's instructions.
- B. Pump or pour material onto substrate. Do not retemper or add water.
 - 1. Pump, move, and screed while the material is still highly flowable.
 - 2. Be careful not to create cold joints.
 - 3. Wear spiked shoes while working in the wet material to avoid leaving marks.
- C. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft (1:1000).
- D. For final thickness over 1-1/2 inches (38 mm), place underlayment in layers. Allow initial layer to harden to the point where the material has lost its evaporative moisture. Immediately prime and begin application of the subsequent layer within 24 hours.
- E. Place before partition installation.
- F. Where additional aggregate has been used in the mix, add a top layer of neat mix (without aggregate), if needed to level and smooth the surface.
- G. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

3.4 CURING

- A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.
- B. Air cure in accordance with manufacturer's instructions.

3.5 PROTECTION

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.
- B. Do not permit traffic over unprotected floor underlayment surfaces.

END OF SECTION

SECTION 04 01 20 - MAINTENANCE OF UNIT MASONRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes special requirements for maintenance of existing unit masonry, including:
 - 1. Repairing unit masonry, including replacing units.
 - 2. Re-anchoring veneers.
 - 3. Repointing joints.
- B. Related Sections:
 - 1. Section 04 05 00 - Common Work Results for Masonry: Quality assurance requirements, mortar, grout, ties and anchors, reinforcement, embedded flashing, masonry water repellent, masonry accessories, and masonry cleaning.
Section 04 20 00 - Unit Masonry: Brick veneer unit masonry.
 - 2. Section 04 21 13 - Brick Masonry: Brick veneer unit masonry.
 - 3. Section 04 22 00 - Concrete Unit Masonry: Single-Wythe CMU walls and CMU backup walls.
 - 4. Section 04 22 00.13 - Concrete Unit Veneer Masonry: Concrete masonry units (CMU) for veneer.
 - 5. Section 04 23 00 - Glass Unit Masonry.
 - 6. Section 04 43 00 - Stone Masonry.
 - 7. Section 04 72 00 - Cast Stone Masonry
 - 8. Section 04 73 23 - Lightweight Synthetic Stone: Manufactured stone veneer, thin brick, and trim.

1.3 SUBMITTALS

- A. Product Data: Technical data for each type of product, including material descriptions and application instructions and test data substantiating that products comply with requirements.
- B. Shop Drawings for the Following:
 - 1. Provisions for expansion joints or other sealant joints.
 - 2. Replacement and repair of anchors. Include details of anchors within individual masonry units, with locations of anchors and dimensions of holes and recesses in units required for anchors.
 - 3. Field investigation report outlining work required after existing construction is removed from masonry surface.

1.4 QUALITY ASSURANCE

- A. Cleaning Program:
 - 1. Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage:
 - a. If materials and methods other than those indicated are proposed for any phase of cleaning work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness.
- B. Mockups:
 - 1. Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution:

- a. Clean an area approximately 25 square feet (2.3 sq. m) for each type of masonry and surface condition:
 - 1) Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
 - 2) Allow a waiting period of not less than seven (7) days after completion of sample cleaning to permit a study of sample panels for negative reactions.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- C. Preconstruction Testing Service:
1. Engage one (1) or more chemical cleaner and paint remover manufacturer(s) to perform pre-construction testing on masonry surfaces:
 - a. Use test areas as indicated and representative of proposed materials and existing construction.
 - b. Propose changes to materials and methods to suit.
- D. Pre-Installation Conference:
1. Conduct conference at Project site:
 - a. Review methods and procedures related to cleaning masonry including, but not limited to, the following:
 - 1) Verify masonry cleaning equipment and facilities needed to make progress and avoid delays.
 - 2) Materials, material application, and sequencing.
 - 3) Cleaning program.
 - 4) Coordination with building occupants.

PART 2 PRODUCTS

2.1 CLEANING MATERIALS

- A. Refer to Section 04 05 00 - Common Work Results for Masonry.

2.2 ACCESSORY MATERIALS

- A. Refer to Section 04 05 00 - Common Work Results for Masonry.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation when existing and forecasted weather conditions permit masonry cleaning work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Clean masonry surfaces only when air temperature is 40 degrees F (4 degrees C) and above and is predicted to remain so for at least seven (7) days after completion of cleaning.

3.2 SEQUENCING AND SCHEDULING

- A. Perform masonry cleaning work in the following sequence:
 1. Remove plant growth.
 2. Inspect for open mortar joints. Where repairs are required, delay further cleaning work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall.
 3. Remove paint.
 4. Clean masonry surfaces.
 5. Where water repellents are to be used on or near masonry, delay application of chemicals until after cleaning.

3.3 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by contact:
 - 1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
 - 2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.
 - 3. Neutralize alkaline and acid wastes before disposal.
 - 4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- B. Remove gutters and/or downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete:
 - 1. Provide temporary rain drainage during work to direct water away from building.

3.4 CLEANING MASONRY

- A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Architect.
- B. Proceed with cleaning working from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.
- C. Use cleaning methods indicated for each masonry material and location:
 - 1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
 - 2. Spray equipment:
 - a. Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints:
 - 1) Equip units with pressure gages.
 - 2) For chemical cleaner spray application, use low pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone shaped spray.
 - 3) For water spray application, use fan shaped spray that disperses water at an angle of 25 to 50 degrees.
 - 4) For high pressure water spray application, use fan shaped spray that disperses water at an angle of at least 40 degrees.
 - 5) For heated water spray application, use equipment capable of maintaining temperature between 140 degrees F and 160 degrees F (60 degrees C and 71 degrees C) at flow rates indicated.
 - 6) For steam application, use steam generator capable of delivering live steam at nozzle.
- D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.

- E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed, so cleaned surfaces blend smoothly into surrounding areas.
- F. Water Application Methods:
 - 1. Water soak application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.
 - 2. Water spray applications: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface and apply water in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.
- G. Steam Cleaning: Apply steam to masonry surfaces at the very low pressures indicated for each type of masonry. Hold nozzle at least 6 inches (150 mm) from masonry surface and apply steam in horizontal back and forth sweeping motion, overlapping previous strokes to produce uniform coverage.
- H. Chemical Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi (345 kPa). Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
- I. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed:
 - 1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.
- J. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

3.5 PRELIMINARY CLEANING

- A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.
- B. Preliminary Cleaning:
 - 1. Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar:
 - a. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
 - b. Remove paint and sealant with alkaline paint remover:
 - 1) Comply with requirements.
 - 2) Repeat application up to two (2) times if needed.
 - c. Remove asphalt and tar with solvent type paste paint remover:
 - 1) Comply with requirements.
 - 2) Apply paint remover only to asphalt and tar by brush without prewetting.
 - 3) Allow paint remover to remain on surface for 10 to 30 minutes.
 - 4) Repeat application if needed.

3.6 CLEANING MASONRY

- A. Cold Water Soak:
 - 1. Apply cold water by intermittent spraying to keep surface moist.
 - 2. Use perforated hoses or other means that apply a fine water mist to entire surface being cleaned.

3. Apply water in cycles of 5 minutes on and 20 minutes off.
 4. Continue spraying until surface encrustation has softened enough to permit its removal by water wash, as indicated by cleaning tests.
- B. Cold Water Wash: Use cold water applied by low, medium, or high pressure spray.
- C. Hot Water Wash: Use hot water applied by low, medium, or high pressure spray.
- D. Steam Cleaning: Apply steam at very low pressures not exceeding 80 psi (550 kPa). Remove dirt softened by steam with wood scrapers, stiff nylon or fiber brushes, or cold-water wash, as indicated by cleaning tests.
- E. Detergent Cleaning:
1. Wet surface with water applied by low pressure spray.
 2. Scrub surface with detergent solution using medium soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used, and that surface remains wet.
 3. Rinse with water applied by high pressure spray to remove detergent solution and soil.
 4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- F. Mold, Mildew, and Algae Removal:
1. Wet surface with water applied by low pressure spray.
 2. Apply mold, mildew, and algae remover by brush.
 3. Scrub surface with medium soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used, and that surface remains wet.
 4. Rinse with cold water applied by medium pressure spray to remove mold, mildew, and algae remover and soil.
 5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- G. Non-Acidic Gel Chemical Cleaning:
1. Wet surface with cold water applied by low pressure spray.
 2. Apply gel cleaner in 1/8 inch (3 mm) thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
 3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
 4. Remove bulk of gel cleaner.
 5. Rinse with water applied by low pressure spray to remove chemicals and soil.
 6. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.
- H. Nonacidic Liquid Chemical Cleaning:
1. Wet surface with water applied by low pressure spray.
 2. Apply cleaner to surface in two (2) applications by brush or low pressure spray.
 3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
 4. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
 5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.
- I. Mild Acid Chemical Cleaning:

1. Wet surface with cold water applied by low pressure spray.
 2. Apply cleaner to surface in two (2) applications by brush or low pressure spray.
 3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
 4. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
 5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.
- J. Acidic Chemical Cleaning:
1. Wet surface with cold water applied by low pressure spray.
 2. Apply cleaner to surface in two (2) applications by brush or low pressure spray.
 3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
- K. One-Part Limestone Chemical Cleaning:
1. Wet surface with water applied by low pressure spray.
 2. Apply cleaner to surface by brush or low pressure spray.
 3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer.
 4. Immediately repeat application of one-part limestone cleaner as indicated above over the same area.
 5. Rinse with water applied by medium pressure spray to remove chemicals and soil.
- L. Two-Part Chemical Cleaning:
1. Wet surface with hot water applied by low pressure spray.
 2. Apply alkaline prewash cleaner to surface by brush or roller.
 3. Let cleaner remain on surface for period recommended in writing by chemical cleaner manufacturer unless otherwise indicated.
 4. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
 5. Apply acidic afterwash cleaner to surface in two (2) applications, while surface is still wet, using low pressure spray equipment, deep nap roller or soft fiber brush. Let neutralizer remain on surface for period recommended in writing by manufacturer unless otherwise indicated.
 6. Rinse with cold water applied by medium pressure spray to remove chemicals and soil.
 7. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer Field Service: Engage paint remover manufacturer's and chemical cleaner manufacturer factory authorized service representatives for consultation and Project site inspection, to perform preconstruction product testing, and provide onsite assistance when requested by Architect. Have paint remover manufacturer and chemical cleaner manufacturer factory authorized service representatives visit site not less than once to observing progress and quality of the work.

3.8 FINAL CLEANING

- A. Clean adjacent non-masonry surfaces of spillage and debris. Use detergent and soft brushes or cloths.
- B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- C. Remove masking materials, leaving no residues that could trap dirt.

END OF SECTION

SECTION 04 29 00 - ENGINEERED UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A Concrete block.
- B Mortar and grout.
- C Reinforcement and anchorage.
- D Accessories.

1.2 RELATED REQUIREMENTS

- A Section 03 20 00 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
- B Section 04 05 11 - Masonry Mortaring and Grouting.

1.3 REFERENCE STANDARDS

- A ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.
- B ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C ASTM A580/A580M - Standard Specification for Stainless Steel Wire; 2023.
- D ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- E ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- F ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- G ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- H ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2022a.
- I ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2023.
- J ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2022b.
- K ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- L ASTM C476 - Standard Specification for Grout for Masonry; 2020.
- M ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2020.
- N ASTM C1019 - Standard Test Method for Sampling and Testing Grout for Masonry; 2020.
- O ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2019.
- P ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2021.
- Q ASTM E518/E518M - Standard Test Methods for Flexural Bond Strength of Masonry; 2021.

1.4 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.

- B Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar and grout.

1.5 PRECONSTRUCTION TESTING

- A Testing will be conducted by an independent test agency, in accordance with provisions of Section 01 40 00 - Quality Requirements.
- B Compressive Strength: Where indicated, test masonry prisms in accordance with ASTM C1314.
 - 1. Prepare two sets of prisms; test one set at 7 days and the other at 28 days.
 - 2. Concrete masonry prisms: Height-to-thickness ratio of not less than 1.33 and not more than 5.0; apply correction factor per TMS 402/602 for ratio other than 2.0.
- C Flexural Bond Strength: Where indicated, test masonry prisms in accordance with ASTM E518/E518M, with tooled joints downward.

1.6 MOCK-UP

- A Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar and accessories, structural backup, reinforcement, grout, flashings, weather barrier, and wall insulation in mock-up.
- B Locate where directed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

1.8 FIELD CONDITIONS

- A Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.
- B Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
 - 2. Special Shapes: Provide non-standard blocks configured for corners.

2.2 MORTAR AND GROUT MATERIALS

- A Mortar and Grout: As specified in Section 04 05 11.

2.3 REINFORCEMENT AND ANCHORAGE

- A Manufacturers:
 - 1. Blok-Lok Limited: www.blok-lok.com/#sle.

2. Hohmann & Barnard, Inc (including Dur-O-Wal brand): www.h-b.com/#sle.
 3. WIRE-BOND: www.wirebond.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B Reinforcing Steel: Type specified in Section 03 20 00; size as indicated on drawings; uncoated finish.
- C Strap Anchors: Bent steel shapes configured as required for specific situations, 1-1/4 in width, 0.105 in thick, lengths as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face, corrugated for embedment in masonry joint, hot dip galvanized to ASTM A153/A153M Class B.
- D Wall Ties: Corrugated formed sheet metal, 7/8 inch wide by 0.05 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.
- E Two-Piece Wall Ties: Formed steel wire, 0.1875 inch thick, adjustable, eye and pintle type, hot dip galvanized to ASTM A 153/A 153M, Class B, sized to provide not less than 5/8 inch of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in.

2.4 ACCESSORIES

- A Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
1. Manufacturers:
 - a. Blok-Lok Limited: www.blok-lok.com/#sle.
 - b. Hohmann & Barnard, Inc (including Dur-O-Wal brand): www.h-b.com/#sle.
 - c. WIRE-BOND: www.wirebond.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.5 MORTAR MIXES

- A Mortar: As specified in Section 04 05 11.
- B Ready Mixed Mortar: ASTM C1142, Type RS.
- C Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
1. Engineered Masonry; Type S.
 2. Masonry below grade and in contact with earth; Type S.
 3. Exterior, loadbearing masonry; Type S.
 4. Interior, loadbearing masonry; Type S.

2.6 MORTAR MIXING

- A Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- B Maintain sand uniformly damp immediately before the mixing process.
- C Do not use anti-freeze compounds to lower the freezing point of mortar.
- D If water is lost by evaporation, re-temper only within two hours of mixing.

2.7 GROUT MIXES

- A Bond Beams and Lintels: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C94/C94M.
- B Engineered Masonry: 3,000 psi strength at 28 days; 8-10 inches slump; provide premixed type in accordance with ASTM C94/C94M.

2.8 GROUT MIXING

- A Mix grout in accordance with ASTM C94/C94M.
- B Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.

PART 3 EXECUTION

3.1 EXAMINATION

- A Verify that field conditions are acceptable and are ready to receive masonry.
- B Verify that related items provided under other sections are properly sized and located.
- C Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

- A Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B Clean reinforcement of loose rust.
- C Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
- D For areas where high-lift grouting will be employed, provide cleanout openings as follows:

3.3 COURSING

- A Establish lines, levels, and coursing indicated. Protect from displacement.
- B Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C Concrete Masonry Units:
 - 1. Bond: Running.

3.4 PLACING AND BONDING

- A Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B Lay hollow masonry units with face shell bedding on head and bed joints.
- C Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D Remove excess mortar as work progresses.
- E Interlock intersections and external corners.
- F Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.5 REINFORCEMENT AND ANCHORAGE

- A Reinforcement Bars: Secure at locations indicated and to avoid displacement during grouting. Minimum spacing between bars or to masonry surfaces shall be one bar diameter.
- B Joint Reinforcement: Install horizontal joint reinforcement 16 inches on center.
- C Anchors: Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type,

space anchors at maximum of 36 inches horizontally and 24 inches vertically.

3.6 GROUTING

- A Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of Contract Documents.
- B Low-Lift Grouting:
 - 1. Limit height of pours to 12 inches.
 - 2. Limit height of masonry to 16 inches above each pour.
 - 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
 - 4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
- C High-Lift Grouting:
 - 1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
 - 2. Place grout for spanning elements in single, continuous pour.

3.7 CONTROL AND EXPANSION JOINTS

- A Do not continue horizontal joint reinforcement through control or expansion joints.
- B Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3.8 TOLERANCES

- A Maximum Variation from Alignment of Columns: 1/4 inch.
- B Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- C Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- D Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- E Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

3.9 FIELD QUALITY CONTROL

- A An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.
- C Mortar Tests: Test each type of mortar in accordance with recommended procedures in ASTM C780, testing with same frequency as masonry samples.
- D Test and evaluate grout in accordance with ASTM C1019 procedures.
- E Prism Tests: Test masonry and mortar panels for compressive strength in accordance with ASTM C1314 and for flexural bond strength in accordance with ASTM C1072 or ASTM E518/E518M; perform tests and evaluate results.

3.10 CLEANING

- A Remove excess mortar and mortar smears as work progresses.
- B Use non-metallic tools in cleaning operations.

3.11 PROTECTION

- A Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 05 05 19 - POST-INSTALLED CONCRETE AND MASONRY ANCHORS

PART 1 – GENERAL

1.1 SUMMARY

- A Section Includes: Cast-in and drilled in anchors for concrete.
- B Related Sections:
 - 1. Division 3 Concrete Sections.
 - 2. Division 4 Masonry Sections.
 - 3. Division 5 Metals Sections.

1.2 SUBMITTALS

- A General: Submit in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
 - 1. Samples: Representative length and diameters of each type anchor shown on the Drawings.
 - 2. Quality Assurance Submittals:
 - a. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
 - 3. Manufacturer's installation instructions.
 - 4. Installer Qualifications & Procedures: Submit installer qualifications as stated in Section 1.03.B. Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.
 - 5. Closeout Submittals: Submit the following:
 - a. Record Documents: Project record documents for installed materials in accordance with Division 1 Closeout Submittals Section.

1.3 QUALITY ASSURANCE

- A Installer Qualifications:
 - 1. Drilled-in anchors shall be installed by a [contractor] [installer] with at least three years of experience performing similar installations.
 - 2. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the [contractor] [installer] on the project. Training to consist of a review of the complete installation process for drilled-in anchors, to include but not limited to:
 - a. hole drilling procedure
 - b. hole preparation & cleaning technique
 - c. adhesive injection technique & dispenser training / maintenance
 - d. rebar dowel preparation and installation

1.4 DELIVERY, STORAGE AND HANDLING

- A General: Comply with Division 1 Section Product Storage and Handling Requirements.
 - 1. Store anchors in accordance with manufacturer's recommendations.

PART 2 – PRODUCTS

2.1 MATERIALS

- A Fasteners and Anchors:
1. Bolts and Studs: ASTM A307; ASTM A449 where “high strength” is indicated on the Drawings.
 2. Carbon and Alloy Steel Nuts: ASTM A563.
 3. Carbon Steel Washers: ASTM F436.
 4. Carbon Steel Threaded Rod: ASTM A36; or ASTM A193 Grade B7; or ISO 898 Class 5.8.
 5. Wedge Anchors: ASTM A510; or ASTM A108.
 6. Stainless Steel Bolts, Hex Cap Screws, and Studs: ASTM F593.
 7. Stainless Steel Nuts: ASTM F594.
 8. Zinc Plating: ASTM B633.
 9. Hot-Dip Galvanizing: ASTM A153.
 10. Reinforcing Dowels: ASTM A615

2.2 CAST-IN-PLACE BOLTS

- A Anchors, Bolts, Nuts, and Washers: Bolts and studs, nuts, and washers shall conform to ASTM A307, Grade A, and ASTM A449, ASTM A563, and ASTM F436, as applicable. Hot-dip galvanized bolts and studs including associated nuts and washers in accordance with ASTM A153.

2.3 DRILLED-IN ANCHORS

- A Wedge Anchors: Wedge type, torque-controlled, with impact section to prevent thread damage complete with required nuts and washers. Provide anchors with length identification markings. Type and size as indicated on Drawings.
1. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
 - a. Hilti Kwik Bolt 3.
 - b. Hilti Kwik Bolt TZ (carbon steel and AISI Type 304 Stainless Steel).
 - c. STRONG-BOLT 2 WEDGE ANCHOR (ICC-ES ESR 3037) BY SIMPSON STRONG-TIE CO., INC
 2. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors manufactured from materials conforming to ISO 898 Part 1, with zinc plating equivalent to ASTM B633, Type III Fe/Zn 5 (5µm min.).
 3. Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be manufactured from materials conforming to ISO 3506 Part 1 and having corrosion resistance equivalent to AISI [Type 304] [and] [Type 316] stainless steel. Stainless steel anchors shall be provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ISO 3506 Part 2 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
- B Screw Anchors: screw type. Pre-drilling of the hole requires a standard ANSI drill bit with the same diameter as the anchor and installing the anchor will be done with an impact wrench.

Provide anchors with a diameter and anchor length marking on the head. Type and size as indicated on Drawings

1. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors with zinc plating equivalent to DIN EN ISO 4042 (8mm min.).
 2. Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be manufactured from materials conforming to ISO 3506 Part 1 and having corrosion resistance equivalent to AISI [Type 304] [and] [Type 316] stainless steel. Stainless steel anchors shall be provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ISO 3506 Part 2 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
 3. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
 - a. Hilti Kwik-HUS-EZ.
 - b. Hilti Kwik-HUS EZ-I.
 - c. Hilti Kwik-HUS.
 - d. TITEN HD SCREW ANCHORS BY SIMPSON STRONG-TIE CO., INC. (ICC REPORT NO. 1067)
- C Heavy Duty Undercut Anchors: Bearing-type. Installed anchor shall have a minimum tension bearing area in the concrete, measured as the horizontal projection of the bearing surface, not less than two times the net tensile area of the anchor bolt. The installed anchor shall exhibit a form fit between the bearing elements and the undercut in the concrete. Type and size as indicated on Drawings.
1. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
 - a. Hilti HDA.
 2. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel anchors manufactured from materials conforming to ISO 898 Part 1, with zinc plating equivalent to ASTM B633, Type III Fe/Zn 5 (5µm min.).
 3. Exterior Use: As indicated on the Drawings, provide sherardized or stainless steel anchors. Sherardized anchors shall be manufactured from materials conforming to ISO 898 Part 1 and having corrosion resistance equivalent to ASTM A153 with sherardized dry diffusion zinc coating (50 µm min.). Stainless steel anchors shall be manufactured from materials conforming to ISO 3506 Part 1 and having corrosion resistance equivalent to AISI [Type 316] stainless steel. Stainless steel anchors shall be provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ISO 3506 Part 2 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
- D Cartridge Injection Adhesive Anchors: Threaded steel rod, inserts or reinforcing dowels, complete with nuts, washers, polymer or hybrid mortar adhesive injection system, and manufacturer's installation instructions. Type and size as indicated on Drawings.
1. Where anchor manufacturer is not indicated, subject to compliance with requirements and acceptance by the Engineer, provide the following:
 - a. Threaded rods with adhesive using Hollow Drill Bit System for anchorage to concrete or masonry.

- b. SIMPSON ACRYLIC-TIE ADHESIVE ANCHORING SYSTEM BY SIMPSON STRONG-TIE CO., INC. (ICBO REPORT NO. 5791),
 - c. SIMPSON SET EPOXY ANCHORING SYSTEM BY SIMPSON STRONG-TIE CO., INC. (ICBO REPORT NO. 5279),
 - d. HILTI HIT HY-70 (MASONRY ONLY)
 - e. HILTI HIT-RE 500
 - f. HILTI HIT-HY 200 (ICC-ES REPORT NO.: ESR.3187)
 - g. SIMPSON ET EPOXY ANCHORING SYSTEM BY SIMPSON STRONG-TIE CO., INC. (ICBO REPORT NO. 4945)
2. Interior Use: Unless otherwise indicated on the Drawings, provide carbon steel threaded rods conforming to ASTM A36, ASTM A 193 Type B7 or ISO 898 Class 5.8 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1) [or carbon steel rods conforming to ASTM A510 with chemical composition of AISI 1038].
 3. Exterior Use: As indicated on the Drawings, provide stainless steel anchors. Stainless steel anchors shall be AISI [Type 304] [and] [Type 316] stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener. All nuts shall conform to ASTM F594 unless otherwise specified. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
 4. Reinforcing dowels shall be A615 Grade 60.

PART 3 – EXECUTION

3.1 INSTALLATION

- A Cast-In-Place Bolts: Use templates to locate bolts accurately and securely in formwork.
 1. Drilled-In Anchors:
 - a. Drill holes with rotary impact hammer drills using [carbide-tipped bits], [hollow drill bit system], [and][or] [core drills using diamond core bits]. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
 - 1) Cored Holes: Where anchors are permitted to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Properly clean cored hole per manufacturer's instructions.
 - 2) Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.
 - 3) Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - b. Perform anchor installation in accordance with manufacturer instructions.
 - c. Wedge Anchors, Heavy-Duty Sleeve Anchors, and Undercut Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in part to be fastened. Set anchors to manufacturer's recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or

fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Engineer.

- d. Cartridge Injection Adhesive Anchors: Clean all holes per manufacturer instructions to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. Follow manufacturer recommendations to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed.
- e. Capsule Anchors: Perform drilling and setting operations in accordance with manufacturer instructions. Clean all holes to remove loose material and drilling dust prior to installation of adhesive. Remove water from drilled holes in such a manner as to achieve a surface dry condition. Capsule anchors shall be installed with equipment conforming to manufacturer recommendations. Do not disturb or load anchors before manufacturer specified cure time has elapsed.
- f. Observe manufacturer recommendations with respect to installation temperatures for cartridge injection adhesive anchors and capsule anchors.

3.2 REPAIR OF DEFECTIVE WORK

- A Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

3.3 FIELD QUALITY CONTROL

- A Testing: 10% of each type and size of drilled-in anchor shall be proof loaded by the independent testing laboratory. Adhesive anchors and capsule anchors shall not be torque tested unless otherwise directed by the Engineer. If any of the tested anchors fail to achieve the specified torque or proof load within the limits as defined on the Drawings, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the Engineer.
 - 1. Tension testing should be performed in accordance with ASTM E488.
 - 2. Torque shall be applied with a calibrated torque wrench.
 - 3. Proof loads shall be applied with a calibrated hydraulic ram. Displacement of adhesive and capsule anchors at proof load shall not exceed $D/10$, where D is the nominal anchor diameter.
 - 4. Minimum anchor embedments, proof loads and torques shall be as shown on the Drawings.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A Structural steel framing members.
- B Base plates, shear stud connectors and expansion joint plates.

1.2 RELATED REQUIREMENTS

- A Section 05 21 00 - Steel Joist Framing.
- B Section 05 31 00 - Steel Decking: Support framing for small openings in deck.
- C Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.3 REFERENCE STANDARDS

- A AISC (MAN) - Steel Construction Manual; 2017.
- B AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
- C AISC S348 - Specification for Structural Joints Using ASTM A325 or A490 Bolts; 2004.
- D ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.
- F ASTM A514/A514M - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding; 2022.
- G ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.
- H AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- I AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).
- J IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.

1.4 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Shop Drawings:
 - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
 - 2. Connections not detailed.
 - 3. Indicate cambers and loads.
 - 4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
- B Structural steel members designated as architecturally-exposed structural steel (AESS) to also comply with Section 05 12 13.
- C Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented documented experience.
- D Fabricator Qualifications: A qualified steel fabricator that is accredited by the AISC

1. As an alternate the fabricator shall fabricate all steel under the review of a special inspector at the cost of the fabricator.

1.6 ERECTOR: COMPANY SPECIALIZING IN PERFORMING THE WORK OF THIS SECTION WITH MINIMUM 5 YEARS OF DOCUMENTED DOCUMENTED EXPERIENCE.

PART 2 PRODUCTS

2.1 MATERIALS

- A Steel Angles and Plates: ASTM A36/A36M.
- B Steel W Shapes and Tees: ASTM A992/A992M.
- C Rolled Steel Structural Shapes: ASTM A992/A992M.
- D Steel Plate: ASTM A514/A514M.
- E Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

2.2 FABRICATION

- A Shop fabricate to greatest extent possible.
- B Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- C Fabricate connections for bolt, nut, and washer connectors.
- D Develop required camber for members.

2.3 FINISH

- A Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.

PART 3 EXECUTION

3.1 ERECTION

- A Erect structural steel in compliance with AISC 303.
- B Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C Field weld components and shear studs indicated on shop drawings.
- D Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts". Bolts in connections not within the slip critical category nor subject to tension loads shall be installed in properly aligned holes and need only be tightened to the snug tight condition. The snug tight condition is defined as the tightness that existis when all plies in a joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Slip critical connections will be identified on the drawings.
- E Do not field cut or alter structural members without approval of Architect/Structural Engineer of Record .
- F After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.2 TOLERANCES

- A Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B Maximum Offset From True Alignment: 1/4 inch.

3.3 FIELD QUALITY CONTROL

- A An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.

END OF SECTION

SECTION 05 12 50 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A This Section includes requirements regarding the appearance and surface preparation of Architecturally Exposed Structural Steel (AESS).
 - 1. Refer to Division 5, Section "Structural Steel" for all other requirements regarding steelwork not included in this section.
 - 2. This section applies to any members noted on Architectural (and Structural) drawings as AESS (and in the areas defined as AESS below).

1.2 RELATED SECTIONS

- A Section 05 12 00 - Structural Steel Framing:
- B Section 05 50 00 - Metal Fabrications:
- C Section 05300 - Metal Deck:
- D Division 9 Section "Special Coatings" for finish coat requirements and coordination with primer and surface preparation specified in this section.
- E Division 9 Section "Painting" for finish coat requirements and coordination with primer and surface preparation specified in this section.

1.3 SUBMITTALS

- A General: Submit each item below according to the Conditions of the Contract and Division 1 Specification Sections.
- B Product Data for each type of product specified.
- C Shop Drawings detailing fabrication of AESS components.
 - 1. Provide erection drawings clearly indicating which members are considered as AESS members.
 - 2. Include details that clearly identify all of the requirements listed in sections 2.3 "Fabrication" and 3.3 "Erection" of this specification. Provide connections for exposed AESS consistent with concepts shown on the architectural or structural drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined herein.
 - 4. Indicate type, size, finish and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tensioned shear/bearing connections. (Indicate to which direction bolt heads should be oriented.)
 - 5. Clearly, indicate which surfaces or edges are exposed and what class of surface preparation is being used.
 - 6. Indicate special tolerances and erection requirements as noted on the drawings or defined herein.
- D Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects names and address, names and addresses of architects and owners, and other information specified.
 - 1. (For each project, submit photographs showing detail of installed AESS.)

1.4 QUALITY ASSURANCE

- A Fabricator Qualifications: In addition to those qualifications listed in Division 5 Section "Structural Steel," engage a firm experienced in fabricating AESS similar to that indicated for this Project with a record of successful in-service performance, as well as sufficient production capacity to fabricate AESS without delaying the Work.
- B Erector Qualifications: In addition to those qualifications listed in Division 5 Section "Structural Steel," engage an experienced Erector who has completed AESS work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- C Comply with applicable provisions of the following specifications and documents:
 - 1. AISC Code of Standard Practice, latest edition, Section 10 as amended herein.
- D Mock-ups: At least four weeks prior to fabricating AESS, the contractor shall construct mock-ups to demonstrate aesthetic effects as well as qualities of materials and execution. A mock-up for each of the following elements shall be constructed:
 - 1. Build mock-ups to comply with the following requirements, using materials indicated for final unit of Work.
 - 2. Locate mock-ups on-site or in the fabricator's shop as directed by Architect. Mock-ups shall be full-size pieces unless the Architect approves smaller models.
 - 3. Notify the Architect one-week in advance of the dates and times when mock-ups will be available for review.
 - 4. Demonstrate the proposed range of aesthetic effects regarding each element listed under the fabrication heading below.
 - 5. Mock-up will have finished surface (including surface preparation and paint system).
 - 6. Obtain Architect's approval of mock-ups before starting fabrication of final units.
 - 7. Retain and maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work.
 - a. Approved mock-ups in an undisturbed condition at the time of Substantial completion may become part of the completed work.

1.5 REFERENCES

- A SSPC-Paint 15 - Steel Joist Shop Paint; Society for Protective Coatings; 1999 (Ed. 2004).
- B AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc.; 2005.
- C AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2006.
- D ASTM A780 - Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

1.6 PRE-INSTALLATION MEETING

- A Convene one week before starting work of this section.
- B Pre-installation Conference: The General Contractor shall schedule and conduct conference at the project site to comply with requirements of Division 1 Section "Project Meetings." As a minimum, the meeting shall include the General Contractor, Fabricator, Erector, the finish-painting subcontractor, and the Architect. Coordinate requirements for shipping, special handling, attachment of safety cables and temporary erection bracing; touch up painting and other requirements for AESS.

1.7 DELIVERY, STORAGE, AND HANDLING

- A Deliver AESS to project site in such quantities and at such times to ensure continuity of installation.
- B Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. Use special care in handling to prevent twisting or warping of AESS members.
- C Erect pre-painted finish pieces using padded slings or other methods such that they are not damaged. Provide padding as required to protect while rigging and aligning member's frames. Weld tabs for temporary bracing and safety cabling only at points concealed from view in the completed structure or where approved by the Architect during the pre-installation meeting. Methods of removing temporary erection devices and finishing the AESS members shall be approved by the Architect prior to erection.

1.8 PROJECT CONDITIONS

- A Field Measurements: Where AESS is indicated to fit against walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

1.9 COORDINATION

- A Coordinate installation of anchors for AESS members that connect to the work of other trades. Furnish setting drawings, templates, and directions for installing anchors, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to the project site in time for installation. (Anchorage concepts shall be as indicated on drawings and approved on final shop drawings.)

PART 2 PRODUCTS

2.1 MATERIALS

- A General:
 - 1. Meet requirements Division 5 Section "Structural Steel" as amended below.
 - 2. High-Strength Bolts, Nuts, and Washers: Per Section 05120 heavy hex heads and nuts (Provide rounded bolt heads with twist bolts): Provide standard carbon steel (Cadmium plated) (Mechanically galvanized) finish.
- B PRIMERS
 - 1. Compatibility: The General Contractor shall submit all components/procedures of the paint system for AESS as a single coordinated submittal. As a minimum, identify required surface preparation, primer, and intermediate coat (if applicable) and finish coat. All of the items shall be coordinated with the finish coat specified in Division 9.
 - 2. Primer: Fabricator's standard alkyd red oxide, rust inhibiting primer.
 - 3. Primer: Fast curing, universal modified alkyd, rust inhibiting shop coat with good resistance to normal atmospheric corrosion. Primer shall comply with all federal standards for VOC, lead and chromate levels.

4. Primer: Acrylic water-soluble shop coat with good resistance to normal atmospheric corrosion. Primer shall comply with all federal standards for VOC, lead and chromate levels.
5. Primer: Fast-curing two-part epoxy. Primer shall comply with all federal standards for VOC, lead and chromate levels.
6. Primer: Organic, epoxy/zinc-rich, meeting class B surface requirements for slip-critical connections. Primer shall comply with all federal standards for VOC, lead and chromate levels.
7. Primer: Inorganic zinc-rich meeting class B surface requirements for slip-critical connections. Primer shall comply with all federal standards for VOC, lead and chromate levels.
8. Galvanizing Repair Paint; High-zinc-dust-content paint for galvanizing welds and repair-painting galvanized steel, with dry-film coating not less than 90-percent zinc dust by weight.

C FABRICATION

1. Fabricate and assemble AESS in the shop to the greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by the Architect. Detail AESS assemblies to minimize field handling and expedite erection.
2. Fabricate AESS with exposed surfaces smooth, square and of surface quality consistent with the approved mock-up. Use special care in handling and shipping of AESS both before and after shop painting.
3. In addition to special care used to handle and fabricate AESS, employ the following fabrication techniques.
4.
 - a. Fabrication Tolerance: Fabricate steel to one half the normal tolerance as specified in the Code of Standard Practice Section 10.
 - b. Welds ground smooth: Fabricator shall grind welds of AESS smooth. For groove welds, the weld shall be made flush to the surfaces each side and be within $+1/16"/-0"$ of plate thickness.
 - c. Contouring and blending of welds: Where fillet welds are indicated to be ground-contoured, or blended, oversize welds as required and grind to provide a smooth transition and to match profile on approved mock-up.
 - d. Continuous Welds: Where welding is noted on the drawings, provide continuous welds of a uniform size and profile.
 - e. Minimize Weld Show Through: At locations where welding on the far side of an exposed connection occurs, grind distortion and marking of the steel to a smooth profile with adjacent material.
 - f. Coping and Blocking Tolerance: Maintain a uniform gap of $1/8"$ & $1/32"$ at all copes and blocks.
 - g. Joint Gap Tolerance: Maintain a uniform gap of $1/8"$ & $1/32"$.
 - h. Piece Marks Hidden: Fabricate such that piece marks are fully hidden in the final structure or made with such media to permit full removal after erection.
 - i. Mill Mark Removal: Fabricator shall deliver steel with no mill marks (stenciled, stamped, raised, etc) in exposed locations. Mill marks shall be omitted by cutting of mill material to appropriate lengths where possible. Where not possible, the fabricator can fill and /or grind to a surface finish consistent with the approved mock-up.
 - j. Grinding of sheared edges: Fabricator shall grind all edges of sheared, punched or flame-cut steel to match approved mock-up.

- k. Rolled Members: Member specified to be rolled to a final curved shape shall be fully shaped in the shop and tied during shipping to prevent stress relieving. Distortion of the web or stem and of outstanding flanges or legs of angles shall be visibly acceptable to the Architect from a distance of 20' under any lighting condition determined by the Architect. Tolerances for the vertical and horizontal walls of rectangular HSS members after rolling shall be the specified dimension & $\frac{1}{2}$ ".
- l. Seal weld open ends of round and rectangular hollow structural section with $\frac{3}{8}$ " closure plates. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where AESS is exposed to weather.

2.2 SHOP CONNECTIONS

- A Bolted Connections: Make in accordance with Section 05120. Provide bolt type, finish as noted herein and align bolt heads as indicated on the approved shop erection drawings.
- B Welded Connections: Comply with AWS D1.1 and Section 05120. Appearance and quality of welds shall be consistent with the mock-up. Assemble and weld built-up sections by methods that will maintain alignment of members without warp exceeding the tolerance of this section.

2.3 SHOP PRIMING

- A Shop-prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2".
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections, if primer does not meet the specified AISC slip coefficient.
- B Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC Specifications as follows:
- C
 - 1. SSPC-SP 1 "Solvent Cleaning"
 - 2. SSPC-SP 2 "Hand Tool Cleaning." (This level of surface preparation will not be adequate for most paint systems for AESS construction.)
 - 3. SSPC-SP 3 "Power Tool Cleansing" (This level of surface prep is the minimum for most AESS projects. It may be acceptable for alkyd primers and acrylic or alkyd finish coats, particularly in interior applications.)
 - 4. SSPC-SP 6 "Commercial Blast Cleaning." (This level of surface prep adds significantly to the total cost of the steel. It is required for epoxy primers to allow adequate bonding to the steel. Recommended for locations where a rust inhibitive primer will be used in an exterior application. It is also required where polyurethane finish coats will be used over the primer.)
 - 5. Coordinate the required blast profile with the approved paint submittal prior to beginning surface preparation.
- D Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop primer to surfaces that are inaccessible after assembly or erection.

2.4 GALVANIZING

- A Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to AESS
 - 1. Indicated for galvanizing according to ASTM A 123. Fabricate such that all connections of assemblies are made in the field with bolted connections. Provide galvanized finish on members and assemblies within the range of color and surface textures presented in the mock-ups.

PART 3 EXECUTION

3.1 EXAMINATION

- A The erector shall check all AESS members upon delivery for twist, kinks, gouges
 - 1. or other imperfections which might result in rejection of the appearance of the member. Coordinate remedial action with fabricator prior to erecting steel.

3.2 PREPARATION

- A Provide connections for temporary shoring, bracing and supports only where noted on the approved shop drawings. Temporary connections not shown shall be made at locations not exposed to view in the final structure or as approved by the Architect. Handle, lift and align pieces using padded slings and/or other protection required to maintain the appearance of the AESS through the process of erection.

3.3 ERECTION

- A Set AESS accurately in locations and to elevations indicated, and according to AISC specifications referenced in this Section.
- B In addition to the special care used to handle and erect AESS, employ the following erection techniques:
 - 1. AESS erection tolerances: Erection tolerances shall meet the requirements of standard frame tolerances for structural steel per Chapter 7 of the AISC Code of Standard Practice.
- C Field welding: Weld profile, quality, and finish shall be consistent with mock-ups approved prior to fabrication.
- D Splice members only where indicated.
- E Obtain permission for any torch cutting or field fabrication from the Architect. Finish sections thermally cut during erection to a surface appearance consistent with the mock up.
- F Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts. Replace connection plates that are misaligned where holes cannot be aligned with acceptable final appearance.

3.4 FIELD CONNECTIONS

- A Bolted Connections: Install bolts of the specified type and finish in accordance with Division 5 section "Structural Steel."
- B Welded Connections: Comply with AWS D1.1 for procedures, and appearance. Refer to Division 5 section "Structural Steel" for other requirements.
 - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp. Verify that weld sizes, fabrication sequence, and equipment used for AESS

will limit distortions to allowable tolerances.

2. Obtain Architect's approval for appearance of welds in repaired or field modified work.
3. Provide continuous all around, sealed welds at angle to gusset-plate connections, tube to tube, and similar locations where connection will allow moisture to get between members and where AESS is exposed to weather or visible to view.

3.5 FIELD QUALITY CONTROL

- A Structural requirements: The Owner will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports. Refer to Division 5 section "Structural Steel" for detailed bolt and weld testing requirements.
- B AESS acceptance: The Architect shall observe the AESS steel in place and determine acceptability based on the mock-up. The Testing Agency shall have no responsibility for enforcing the requirements of this section.

3.6 ADJUSTING AND CLEANING

- A Touch-up painting: Cleaning and Touch-up painting for field welds, bolted connections, and abraded areas of shop paint shall be completed to blend with the adjacent surfaces of AESS. Such touch up work shall be done in accordance with manufacturer's instructions as specified in Division 9, Section "Painting."
- B Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.
 1. Repair Materials for Galvanized Surfaces Exposed to View: ASTM A780, zinc based solder, color matched to material being repaired.

END OF SECTION

SECTION 05 21 00 - STEEL JOIST FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A Open web steel joists and shear stud connectors, with bridging, attached seats and anchors.
- B Loose bearing members, such as plates or angles, and anchor bolts for site placement.
- C Supplementary framing for floor and roof openings greater than 18 inches.

1.2 RELATED REQUIREMENTS

- A Section 05 12 00 - Structural Steel Framing: Superstructure framing.
- B Section 05 31 00 - Steel Decking: Support framing for openings less than 18 inches in decking.

1.3 REFERENCE STANDARDS

- A AISC S348 - Specification for Structural Joints Using ASTM A325 or A490 Bolts; 2004.
- B ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2018.
- D ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- E ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- F AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).
- G SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders; 2008.
- H SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- I SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

1.4 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.

1.5 QUALITY ASSURANCE

- A Manufacturer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.
- B Erector Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A Transport, handle, store, and protect products to SJI requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A Steel Joists:

1. Canam Group Inc: www.canam-steeljoists.ws
2. Nucor-Vulcraft Group: www.vulcraft.com/#sle.
3. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MATERIALS

- A Open Web Joists: SJI Type K Joists:
 1. Provide bottom chord extensions as indicated.
 2. End bearing of 2-1/2 inches on steel supports.
 3. Finish: Shop primed.
 4. End bearing of 2-1/2 inches on steel supports.
- B Anchor Bolts, Nuts and Washers: ASTM A307 hot-dip galvanized per ASTM A153/A153M Class C.
- C Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A 36/A 36M.
- D Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- E Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.3 FINISH

- A Shop prime joists as specified.
 1. Do not prime surfaces that will be fireproofed.
- B Prepare surfaces to be finished in accordance with SSPC-SP 2.

PART 3 EXECUTION

3.1 EXAMINATION

- A Verify existing conditions prior to beginning work.

3.2 ERECTION

- A Erect joists with correct bearing on supports.
- B Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.
- C Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.
- D After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.
- E Install supplementary framing for floor and roof openings greater than 18 inches.
- F Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
- G Do not field cut or alter structural members without approval of joist manufacturer.
- H After erection, prime welds, damaged shop primer, damaged galvanizing, and surfaces not shop primed , except surfaces specified not to be primed.

3.3 TOLERANCES

- A Maximum Variation From Plumb: 1/4 inch.
- B Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION

SECTION 05 31 00 - STEEL DECKING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A Roof deck.
- B Composite floor deck.
- C Metal form deck.
- D Supplementary framing for openings up to and including 18 inches.
- E Bearing plates and angles.

1.2 RELATED REQUIREMENTS

- A Section 03 20 00 - Concrete Reinforcing.
- B Section 03 30 00 - Cast-in-Place Concrete: Concrete topping over metal deck.
- C Section 05 12 00 - Structural Steel Framing: Support framing for openings larger than 18 inches and shear stud connectors.
- D Section 05 21 00 - Steel Joist Framing: Support framing for openings larger than 18 inches and shear stud connectors.

1.3 REFERENCE STANDARDS

- A ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).
- D AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.
- E SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.
- F SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- G SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
- H SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II; Society for Protective Coatings; 1997 (Ed. 2004).

1.4 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements, for submittals procedures.
- B Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
- C Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A Steel Deck:
1. Nucor-Vulcraft Group: www.vulcraft.com/#sle.
 2. Wheeling Corrugating Co: www.wheelingcorrugating.com.
 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 STEEL DECK

- A 1 1/2" Roof Deck(1.5B): Non-composite type, steel sheet.
1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
 2. Structural Properties:
 - a. Span Design: Double.
 3. Minimum Metal Thickness, Excluding Finish: 20 gage.
 4. Nominal Height: 1-1/2 inch.
 5. Profile: Fluted; SDI WR; 1.5B.
 6. Formed Sheet Width: 36 inch.
 7. Side Joints: Lapped, welded.
 8. End Joints: Lapped, welded.
 9. Fasten deck to steel support members at ends and intermediate supports with 3/4" pattern. Where deck is continuously supported weld 12 inches on center.
 - a. Welding: Use fusion welds, 3/4" dia puddle welds.
 10. Provide 1 - # 10 TEK screws minimum per side lap.
- B 3" Roof Deck(3N): Non-composite type, fluted steel sheet:
1. Ungalvanized Steel Sheet: ASTM A 1008/A 1008M, Designation SS, Grade 33, Type 1.
 2. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.
 3. Structural Properties:
 - a. Span Design: Double.
 4. Minimum Metal Thickness, Excluding Finish: 20 gage.
 5. Nominal Height: 3 inch.
 6. Profile: Fluted3N.
 7. Formed Sheet Width: 24 inch.
 8. Side Joints: Lapped, mechanically fastened.
 9. End Joints: Lapped, welded.
 10. Fasten deck to steel support members at ends and intermediate supports with 24/4" pattern. Where deck is continuously supported weld 12 inches on center.
 - a. Welding: Use fusion welds, 3/4" dia puddle welds.
 11. Provide 5 - # 10 TEK screws minimum per side lap.
- C Composite Floor Deck(2.0VLI): Fluted steel sheet embossed to interlock with concrete:
1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
 2. Structural Properties:
 3. Span Design: Double.
 4. Minimum Base Metal Thickness: 22 gauge, 0.0299 inch.

5. Nominal Height: 2 inches.
 6. Profile: Composite Steel Deck; ; SDI NR2.0VLI .
 7. Formed Sheet Width: 36 inch.
 8. Side Joints: Lock seam.
 9. End Joints: Lapped, welded.
 10. Fasten deck to steel support members at ends and intermediate supports with 36/4 pattern. Where deck is continuously supported weld 12 inches on center.
 - a. Welding: Use fusion welds, 3/4" dia puddle welds.
 11. Provide 2 - # 10 TEK screws minimum per side lap.
- D Metal Form Deck(0.6C): Corrugated sheet steel, with provision for ventilation of concrete:
1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 33/230, with G90/Z275 galvanized coating.
 2. Minimum Base Metal Thickness: 26 gauge.
 3. Nominal Height: 9/16 inch.
 4. Profile: Non-Composite Form Deck; 0.6C.
 5. Formed Sheet Width: 30 inch.
 6. Side Joints: Lapped mechanically fastened.
 7. End Joints: Lapped, welded.
 8. Fasten deck to steel support members at ends and intermediate supports with 30/4 pattern. Where deck is continuously supported weld 12 inches on center.
 - a. Welding: Use fusion welds through weld washers, 5/8" dia puddle welds.

2.3 ACCESSORY MATERIALS

- A Bearing Plates and Angles: ASTM A36/A36M steel unfinished.
- B Welding Materials: AWS D1.1/D1.1M.
- C Fasteners: Galvanized hardened steel, self tapping.
- D Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.
- E Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- F Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
- G Acoustical Insulation: Glass fiber type, minimum 1.1 lb/cu ft density; profiled to suit deck.

PART 3 EXECUTION

3.1 EXAMINATION

- A Verify existing conditions prior to beginning work.

3.2 INSTALLATION

- A Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
- B On concrete and masonry surfaces provide minimum 4 inch bearing.
- C On steel supports provide minimum 1-1/2 inch bearing.
- D At cellular/plated deck level and align deck within 1/8 inch horizontally and vertically. Butt ends, allow for maximum 1/8 inch gap. Install sheet steel covers over gaps wider than 1/8 inch. Tape and seal joints watertight.

- E Clinch lock seam side laps.
- F At mechanically fastened male/female side laps fasten at 24 inches on center maximum.
- G At welded male/female side laps weld at 18 inches on center maximum.
- H Weld deck in accordance with AWS D1.3/D1.3M.
- I At deck openings less than 6 inches in size, provide additional sheet of deck lapped 24" each side of hole and a minimum two flutes beyond each side of opening. Attach to base deck with #10 TEK screws at 12" o.c.
- J At deck openings from 6 inches to 18 inches in size, provide 2 by 2 by 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.
- K Where deck changes direction, install 8 inch minimum wide by 1/4 inch thick sheet steel cover plates. Fusion weld 12 inches on center maximum.
- L At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.
- M Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A Formed steel stud exterior wall and interior wall framing.
- B Steel Stud exterior wall framing.

1.2 RELATED REQUIREMENTS

- A Section 05 31 00 - Steel Decking.
- B Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.3 REFERENCE STANDARDS

- A AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).
- B ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2021a.
- E ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members; 2018, with Editorial Revision.
- F ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
- G AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).
- H AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.

1.4 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.
- C Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
- D Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
 - 1. Indicate stud layout.
 - 2. Describe method for securing studs to tracks and for welded framing connections.
 - 3. Design data:
 - 4. Calculations for loadings and stresses of specially fabricated framing, signed and sealed by a professional structural engineer.
- E Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention .

1.5 QUALITY ASSURANCE

- A Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Texas.
- B Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A Metal Framing:
 - 1. The Steel Network, Inc: www.SteelNetwork.com/#sle.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B Framing Connectors and Accessories:

2.2 FRAMING SYSTEM

- A Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
- B Design Requirements: Provide completed framing system having the following characteristics:
 - 1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100.
 - 2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
 - 3. Design Loads: In accordance with applicable codes.
 - 4. Deflections:
 - a. Exterior Walls: Maximum horizontal deflection under wind load:
 - 1) Brick - 1/600 of span.
 - 2) EIFS and Stucco - 1/360 of span.
 - 3) Wood or Metal Siding - 1/180 of span.
 - 5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
 - 6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.3 FRAMING MATERIALS

- A Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.
 - 1. Gauge and Depth: As required to meet specified performance levels.
 - 2. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.
 - 3. Provide components fabricated from ASTM A1008/A1008M Designation SS (structural steel).
- B Framing Connectors: Factory-made, formed steel sheet.
 - 1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gauge, 0.1345 inch, and factory punched holes and slots.

2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100.
3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
 - a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
 - b. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
 - c. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 10 feet.
4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

PART 3 EXECUTION

3.1 EXAMINATION

- A Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION OF STUDS

- A Install components in accordance with ASTM C1007 requirements and ASTM C1007 requirements.
- B Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center. Coordinate installation of sealant with floor and ceiling tracks.
- C Place studs at 16 inches minimum on center; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clip and tie method.
- D Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
- E Install intermediate studs above and below openings to align with wall stud spacing.
- F Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
- G Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- H Touch-up field welds and damaged galvanized surfaces with primer.

3.3 TOLERANCES

- A Maximum Variation from True Position: 1/4 inch.
- B Maximum Variation of any Member from Plane: 1/4 inch.

END OF SECTION

SECTION 05 51 00 - METAL STAIRS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 - 1. Preassembled steel stairs.
 - 2. Concrete-filled metal pan stairs.
 - 3. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 05 52 00 - Metal Railings: Railings for use with Metal Stairs.
- C. Related Standards:
 - 1. 2019 California Building Code (CBC): 11B-504.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- C. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2016).
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- G. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel; 2020.
- H. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing; 2020a.
- I. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.
- J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- K. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- L. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023.
- M. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- N. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.

- O. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- P. ASTM B455/B455M - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2020.
- Q. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications; 2022.
- R. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- S. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
- T. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- U. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2022.
- V. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2009 (Reapproved 2020).
- W. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).
- X. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
- Y. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer licensed in the State of Texas and experienced in the design of steel stairs and railings to design stairs and railings.
- B. Structural Performance of Stairs:
 - 1. Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - a. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
 - b. Concentrated load: 300 lbf (1.33 kN) applied on an area of four (4) square inches (2580 sq. mm).
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - d. Stair framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - e. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.
- C. ADA Compliance Guidelines:
 - 1. Treads, Riser, and Nosings:
 - a. Interior stairs shall have the upper approach and lower tread marked by a stripe providing clear visual contrast. Exterior stairs shall have the upper approach and all treads marked by a stripe providing clear visual contrast.
 - b. Stripe providing clear visual contrast shall be between 2 inches and 4 inches wide placed parallel to, and not more than 1 inch from the nose of the step or upper approach. The stripe shall extend the full width of the step or upper approach and shall be of material that is at least as slip resistant as the other treads of the stair. A painted stripe shall be acceptable. Grooves shall not be used to satisfy this requirement.
 - c. Radius of curvature at the leading edge of the tread shall be no greater than 1/2 inch. Nosings that project beyond riser shall have the underside of the leading edge curved or beveled. The maximum angle for a rise to slope under the tread shall be 30

degrees from vertical. Nosings shall extend 1-1/4 inch maximum over the tread below.

- d. Treads shall be 11 inches deep minimum. Risers shall be between 4 inches and 7 inches high. All steps on a flight of stairs shall have uniform riser heights and uniform tread depths. Open risers are not permitted.

1.5 SUBMITTALS

- A. Product Data:
 1. Technical data for metal pan stairs and the following:
 - a. Prefilled metal pan stair treads.
 - b. Precast concrete treads.
 - c. Epoxy resin filled stair treads.
 - d. Nonslip aggregates and nonslip aggregate finishes.
 - e. Abrasive nosings.
 - f. Paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type and finish of nosing and tread.
- D. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Welding Certificates.
- F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Welding qualifications:
 - a. Qualify procedures and personnel according to the following:
 - 1) AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
- B. Installer Qualifications: Fabricator of products, having minimum of five (5) years documented experience in the fabrication and installation of metal stairs.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 1. American Stair Corporation, Inc.; (800) 872-7824.
 2. Lapeyre Stair Inc.; (800) 535-7631.
 3. Pacific Stair Corporation; (888) 477-8247.
- B. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- C. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- D. Steel Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M.
- E. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- F. Uncoated, Cold Rolled Steel Sheet: ASTM A1008/A1008M, structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

- G. Uncoated, Hot Rolled Steel Sheet: ASTM A1011/A1011M, structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.
- H. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating, structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.
- I. Expanded Metal, Carbon Steel: ASTM F1267, Class 1 (uncoated).
- J. Perforated Metal: Cold rolled steel sheet, ASTM A1008/A1008M, or hot rolled steel sheet, ASTM A1011/A1011M, commercial steel Type B.
- K. Perforated Metal: Galvanized steel sheet, ASTM A653/A653M, G90 (Z275) coating, commercial steel Type B.
- L. Woven Wire Mesh: Intermediate crimp, two-inch (50 mm) woven wire mesh, made from 0.135 inch (3.5 mm) nominal diameter wire complying with ASTM A510/A510M.
- M. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
- N. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.
- O. Bronze Extrusions: ASTM B455/B455M, Alloy UNS No. C38500 (extruded architectural bronze).
- P. Bronze Castings: ASTM B584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semi-red brass).
- Q. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).
- R. Fasteners:
 - 1. Provide zinc plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required:
 - a. Bolts and Nuts: Regular hexagon head bolts, ASTM A307, Grade A with hex nuts, ASTM A563/A563M and, where indicated, flat washers.
 - b. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563/A563M and, where indicated, flat washers:
 - 1) Provide mechanically deposited or hot dip, zinc coated anchor bolts.
 - c. Post Installed Anchors:
 - 1) Torque controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency:
 - (a) Material for interior locations: Carbon steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - (b) Material for exterior locations and where stainless steel is indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 and nuts, ASTM F594.
- S. Miscellaneous Materials:
 - 1. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide Series 10 Tnemec Primer by Tnemec.
 - 2. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
 - 3. Water Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel and compatible with topcoat.

4. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
 5. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Series 90-97 Tneme-Zinc by Tnemec.
 6. Bituminous Paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D1187/D1187M.
 7. Concrete Materials and Properties: Comply with requirements in Section 03 30 00 - Cast-In-Place Concrete for normal weight, air entrained, ready mix concrete with a minimum 28-day compressive strength of 3,000 psi (20 MPa) unless otherwise indicated.
 8. Non-Slip Aggregate Concrete Finish: Factory packaged abrasive aggregate made from fused, aluminum oxide grits or crushed emery; rustproof and non-glazing; unaffected by freezing, moisture, or cleaning materials.
 9. Welded Wire Reinforcement: 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.
- T. Precast Concrete Treads:
1. Concrete materials and properties: Comply with requirements in Section 03 30 00 - Cast-In-Place Concrete for normal weight, ready mixed concrete with a minimum 28-day compressive strength of 5,000 psi (35 MPa) and a total air content of not less than four percent (4%) or more than six percent (6%).
 2. Reinforcement: Galvanized, welded wire reinforcement, two inches by two inches (50 mm by 50 mm) by 0.062-inch (1.6 mm) diameter wire.

2.2 FABRICATION

- A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure:
1. Join components by welding unless otherwise indicated.
 2. Use connections that maintain structural value of joined pieces.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.3 FINISHES

- A. Finish metal stairs after assembly.
- B. Galvanizing:

1. Hot dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products:
 - a. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - b. Fill vent and drain holes that are exposed in the finished work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with SSPC-SP 3 Power Tool Cleaning.
- D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1 Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel for shop painting.

PART 3 EXECUTION

3.1 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they do not encroach on required stair width and are within the fire-resistance rated stair enclosure.

3.2 INSTALLING METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Place and finish concrete fill for treads and platforms to comply with Section 03 30 00 - Cast-In-Place Concrete. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.
- G. Install precast concrete treads with adhesive supplied by manufacturer.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting:
 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC PA1 for touching up shop painted surfaces:
 - a. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.

- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

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SECTION 05 52 00 - METAL RAILINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Aluminum pipe and tube railings.
 - 2. Steel pipe and tube railings.
 - 3. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

- A. 2012 TAS - Texas Accessibility Standards; 2012.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- G. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing; 2020a.
- H. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- I. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- J. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- K. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
- L. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.
- M. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.
- N. ASTM F2329/2329M - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners; 2015.
- O. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- P. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- Q. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018.
- R. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017, with Amendment (2021).

1.4 SUBMITTALS

- A. Product Data:

1. Technical data for railings and the following:
 - a. Manufacturer's product lines of mechanically connected railings.
 - b. Railing brackets.
 - c. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples:
 1. For each type of exposed finish required:
 - a. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
 - b. Fittings and brackets.
 - c. Assembled sample of railing system, made from full size components, including top rail, post, handrail, and infill. Sample need not be full height:
 - 1) Show method of connecting and finishing members at intersections.
- D. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Qualification Data: For testing agency.
- F. Mill Certificates: Signed by manufacturers of stainless steel products certifying that products furnished comply with requirements.
- G. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- H. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935 .
- I. Evaluation Reports: For post installed anchors, from ICC-ES.

1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer licensed in the State of California and experienced in the design of railings, including attachment to building construction.
- B. Structural Performance:
 1. Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - a. Handrails and Top Rails of Guards:
 - 1) Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - 2) Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - 3) Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of one square foot (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements:
 1. Allow for thermal movements from ambient and surface temperature changes:
 - a. Temperature change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C, material surfaces).

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Accessibility Requirements:
 - a. Texas Accessibility Standards, 2012 Edition (2012 TAS).
 2. Welding qualifications: Qualify procedures and personnel according to the following:
 - a. AWS D1.1/D1.1M Structural Welding Code – Steel.

- b. AWS D1.2/D1.2M Structural Welding Code - Aluminum.
- c. AWS D1.3/D1.3M Structural Welding Code - Sheet Steel.
- d. AWS D1.6/D1.6M Structural Welding Code - Stainless Steel.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
- 1. Steel Pipe and Tube Railings:
 - a. Industrial Metal Supply Co., 1-818-729-3333.
 - B. Metal Surfaces: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
 - C. Brackets, Flanges, and Anchors:
 - 1. Formed metal of same type of material and finish as supported rails unless otherwise indicated:
 - a. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2 inch (38 mm) clearance from inside face of handrail to finished wall surface.
 - D. Steel and Iron:
 - 1. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M.
 - 2. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 3. Plates, Shapes, and Bars: ASTM A36/A36M.
 - E. Fasteners:
 - 1. Ungalvanized Steel Railings: Plated steel fasteners complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.
 - 2. Hot Dip Galvanized Railings: Type 304 stainless steel or hot dip zinc coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/2329M for zinc coating.
 - 3. Provide exposed fasteners with finish matching appearance, including color and texture of railings.
 - 4. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
 - 5. Fasteners for Interconnecting Railing Components:
 - a. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
 - b. Provide tamper resistant hex socket flat head machine screws for exposed fasteners unless otherwise indicated.
 - F. Miscellaneous Materials:
 - 1. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 2. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
 - 3. Galvanizing Repair Paint: High zinc dust content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

4. Shop Primer for Ferrous Metal: Universal primer, organic zinc rich primer, complying with SSPC-Paint 20 and compatible with topcoat. Provide 10-99 (red) or 10-09 (gray) by Tnemec Company.
5. Universal Shop Primer: Fast curing, lead and chromate free, universal modified alkyd primer and compatible with topcoat. Use primer containing pigments that make it easily distinguishable from zinc rich primer.
6. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc coated metal and compatible with finish paint systems indicated.
7. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in steel, complying with SSPC-Paint 20. Provide Tneme-Zinc 90-97 by Tnemec Company.
8. Bituminous paint: Cold applied asphalt emulsion complying with SSPC-Paint 12, containing no asbestos fibers, or cold applied asphalt emulsion complying with ASTM D1187/D1187M.
9. Non-Shrink, Non-Metallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.2 STEEL TUBE RAILING SYSTEMS

- A. Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads:
 1. Rails and Posts: Size and finish as indicated on Drawings.

2.3 INFILL

- A. Cable:
 1. Material: Stainless steel.
 2. Diameter: 3/16 inch.
 3. Fittings: Quick connect.
- B. Picket Infill:
 1. Size: As indicated on Drawings.
 2. Spacing: As indicated on Drawings.

2.4 FABRICATION, GENERAL

- A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.
- H. Welded Connections:

1. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings:
 2. Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- I. Non-Welded Connections:
1. Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints:
 - a. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- J. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Exposed Ends: Close exposed ends of railing members with prefabricated end fittings.
- L. Returns:
1. Provide wall returns at ends of wall mounted handrails unless otherwise indicated.
 2. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- M. Brackets, Flanges, Fittings, and Anchors:
1. Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work:
 - a. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous metal components.
 - b. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt that provides 1-1/2 (38 mm) clearance from inside face of handrail to finished wall surface.
 2. Fillers: Provide fillers made from steel plate, or other suitably crush resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- O. For railing posts set in concrete, provide steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.
- P. For removable railing posts, fabricate slip fit sockets from steel tube or pipe whose Interior Diameter is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than 1/40 of post height. Provide socket covers designed and fabricated to resist being dislodged.
- Q. Toe Boards:
1. Where indicated, provide toe boards at railings around openings and at edge of open sided floors and platforms.
 2. Fabricate to dimensions and details indicated.
 3. Fabricate of same material as railings unless noted otherwise.

2.5 FABRICATION OF ALUMINUM RAILINGS

- A. Connections shall be welded, unless noted otherwise.
- B. Form Changes in Direction As detailed.

2.6 FABRICATION OF STEEL RAILINGS

- A. Connections shall be welded, unless noted otherwise.
- B. Form Changes in Direction As detailed.
- C. Connect posts to stair framing by direct welding unless otherwise indicated.
- D. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- E. For Non-Galvanized Steel Railings: Provide non-galvanized ferrous metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.

2.7 FINISHES

- A. Steel and Iron Finishes:
 - 1. Galvanized Railings:
 - a. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
 - b. Comply with ASTM A123/A123M for hot dip galvanized railings.
 - c. Comply with ASTM A153/A153M for hot dip galvanized hardware.
 - d. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - e. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Painted Railings:
 - a. Preparation for Shop Priming:
 - 1) Prepare uncoated ferrous metal surfaces to comply with SSPC SP6/NACE No. 3 Commercial Blast Cleaning:
 - (a) Exterior Railings: SSPC SP6/NACE No. 3 Commercial Blast Cleaning.
 - (b) Railings to Receive Zinc Rich Primer: SSPC-SP 6/NACE No. 3 Commercial Blast Cleaning.
 - (c) Other Railings: SSPC SP3 Power Tool Cleaning.
 - b. Primer Application:
 - 1) Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC PA1 Shop, Field, and Maintenance Painting of Steel for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - 2) Do not apply primer to galvanized surfaces.
 - c. Paint:
 - 1) Finish - comply with Section 09 90 00 - Painting and Coating.
 - 2) Color and Gloss: As selected by Architect.
 - d. High Performance Coating:
 - 1) Apply epoxy intermediate and polyurethane topcoats to prime coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC PA1 Shop, Field, and Maintenance Painting of Steel for shop painting. Apply at spreading rates recommended by coating manufacturer:
 - 2) Color and Gloss: As selected by Architect.

PART 3 EXECUTION

3.1 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacture's written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items

with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.
- D. Coordinate with District on railings specific to animal control or livestock access.

3.2 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.
- B. Grade elevation review to actual conditions.
- C. Coordinate elevation to specific use with livestock, large and small.

3.3 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for installer. Locate reinforcements and mark locations if not already done.

3.4 INSTALLATION

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack:
 - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in three feet (2 mm in 1 m).
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- C. Control of Corrosion:
 - 1. Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials:
 - a. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.5 RAILING CONNECTIONS

- A. Non-Welded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip joint internal sleeve extending two inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within six inches (150 mm) of post.

3.6 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than outside diameter of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members:
 - 1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
 - 2. For stainless steel pipe railings, weld flanges to post and bolt to supporting surfaces.
 - 3. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
- E. Install removable railing sections, where indicated, in slip fit metal sockets cast in concrete.

3.7 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and to railing ends using nonwelded connections.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and connected to railing ends using nonwelded connections.
- C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled in expansion shields and hanger or lag bolts.
 - 2. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 3. For steel framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.8 ADJUSTING AND CLEANING

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC PA1 requirements for touching up shop painted surfaces:
 - a. Apply by brush or spray to provide a minimum 2.0 mil (0.05 mm) dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

3.9 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 05 55 16 - METAL STAIR NOSINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Extruded aluminum finishing and edge-protection profiles for stair nosings
 - 2. Steel finishing and edge-protection profiles for stair nosings
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 06 10 00 - Rough Carpentry: Plywood subfloor and underlayment
 - 3. Section 07 92 00 - Joint Sealants.
 - 4. Section 09 21 16 - Gypsum Board Assemblies: Gypsum board and tile backer boards
 - 5. Section 10 26 00 - Wall and Door Protection.

1.3 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2019.
- B. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2023.

1.4 REFERENCES

- A. Tile Council of North America (TCNA (HB)) Handbook for Ceramic Tile Installation
- B. Terrazzo, Tile and Marble Association of Canada (TTMAC) Specification Guide 09300 Tile Installation Manual
- C. American National Standard Specifications for the Installation of Ceramic Tile ANSI A108/A118/A136.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Cast Metal Units:
 - a. American Safety Tread Co., Inc.
 - b. Barry Pattern & Foundry Co., Inc.
 - c. Granite State Casting Co.
 - d. Nystrom, Inc.
 - e. Safe-T-Metal Company, Inc.
 - f. Wooster Products Inc.
 - 2. Extruded Metal Units:
 - a. ACL Industries, Inc.
 - b. American Safety Tread Co., Inc.
 - c. Amstep Products.
 - d. Armstrong Products, Inc.
 - e. Balco/Metalines.
 - f. Granite State Casting Co.

- g. Nystrom, Inc.
 - h. Pemko Manufacturing Co.
 - i. Safe T Metal Co.
 - j. Schluter Systems, L.P.
3. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 STAIR NOSINGS

- A. Cast Metal Units:
- 1. Description: Cast aluminum with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 2. Configuration: Cross-hatched units, 3 inches (75 mm) wide without lip.
- B. Extruded Metal Units:
- 1. Description: Extruded aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both in an epoxy resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 2. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
 - 3. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.
 - 4. Apply clear lacquer to concealed surfaces of extruded units set into concrete.
 - 5. MSN-_____: Aluminum Stair Nosing
 - a. Description: Two-component, 3-1/4 inch deep by 9/16 inch high aluminum stair nosing with ribbed abrasive strips.
 - b. Basis of Design: Model DST-330 as manufactured by Balco.
 - c. Finish: Mill Finished Aluminum with abrasive strips in color as selected by Architect.
 - 6. MSN-_____: Aluminum Stair Nosing
 - a. Description: 1-1/4 inch wide by 1-1/8 inch high nail-down style aluminum stair nosing.
 - b. Basis of Design: Model 2120 as manufactured by Pemco.
 - c. Finish: As selected by Architect.
 - 7. MSN-_____: Aluminum Stair Nosing
 - a. Description: anodized aluminum profile with symmetrically-rounded top surface with 1/4 inch (6 mm) radius and vertical leg that together form the exposed surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - b. Basis of Design: Schluter®-RONDEC-STEP.
 - c. Corners: AS indicated on Drawings.
 - d. Finish: ACGB - Brushed Chrome Anodized Aluminum.
 - e. Vertical Leg Length: As required.
 - f. Height: As required.
 - 8. MSN-_____: Composite Stair Nosing
 - a. Description: Roll-formed stainless steel profile with ribbed, 1-3/16 inch (30 mm) wide exposed surface with rounded leading edge and integrated trapezoid-perforated anchoring leg.
 - b. Basis of Design: Schluter®-TREP-E.
 - c. Material and Finish: E - Stainless Steel Type 304 = V2A.
 - d. End Caps: Provide matching end caps.
 - e. Height: As required.
 - 9. MSN-_____: Composite Stair Nosing
 - a. Description: Roll-formed stainless steel profile with ribbed, 1-5/16 inch (33 mm) wide exposed surface with rounded leading edge for surface attachment to stair tread.
 - b. Basis of Design: Schluter®-TREP-EK.
 - c. Material and Finish: E - Stainless Steel Type 304 = V2A.
 - d. Height: As required.

- e. Description: Roll-formed stainless steel profile with ribbed, 1-3/16 inch (33 mm) wide exposed surface with rounded leading edge for surface attachment to stair tread.
 - f. Basis of Design: Schluter®-TREP-G-S.
 - g. Material and Finish: E - Stainless Steel Type 304 = V2A.
 - h. Height: As required.
 - i. Abrasive Strip Color:
10. MSN-_____: Composite Stair Nosing
- a. Description: Roll-formed stainless steel profile with ribbed, 2-5/32 inch (55 mm) wide exposed surface with rounded leading edge for surface attachment to stair tread.
 - b. Basis of Design: Schluter®-TREP-G-B.
 - c. Material and Finish: E - Stainless Steel Type 304 = V2A.
 - d. Height: As required.
 - e. Abrasive Strip Color:
11. MSN-_____: Composite Stair Nosing
- a. Description: Profile with replaceable, ribbed, 1-1/32" (26 mm) wide, thermoplastic rubber exposed surface with rounded leading edge, and roll-formed stainless steel type 304 = V2A support section with integrated trapezoid-perforated anchoring leg.
 - b. Basis of Design: Schluter®-TREP-SE.
 - c. Material and Finish: Thermoplastic tread with Stainless Steel Type 304 = V2A support.
 - d. Height: As required.
 - e. Tread Color: CG – Yellow.
12. MSN-_____: Composite Stair Nosing
- a. Description: Profile with replaceable, ribbed, 1-1/32 inch (26 mm) wide, thermoplastic rubber exposed surface with rounded leading edge and extruded aluminum support section with integrated trapezoid-perforated anchoring leg.
 - b. Basis of Design: Schluter®-TREP-S.
 - c. Material and Finish: Thermoplastic tread with aluminum support.
 - d. Height: As required.
 - e. Tread Color: CG – Yellow.
13. MSN-_____: Composite Stair Nosing
- a. Description: Profile with replaceable, ribbed, 1-1/32 inch (26 mm) wide, thermoplastic rubber exposed surface with rounded leading edge and extruded aluminum support section with integrated trapezoid-perforated anchoring leg.
 - b. Basis of Design: Schluter®-TREP-B.
 - c. Material and Finish: Thermoplastic tread with aluminum support.
 - d. Height: As required.
 - e. Tread Color: CG – Yellow.
14. MSN-_____: Composite Stair Nosing
- a. Description: profile, with 11/32 inch (9 mm) wide, 13/16 inch (21 mm) tall, exposed surface with rounded leading edge and integrated trapezoid-perforated anchoring leg.
 - b. Basis of Design: Schluter®-TREP-FL.
 - c. Material and Finish: E - Stainless Steel Type 304 = V2A.
 - d. Height: As required.
 - e. End Caps: Provide matching end caps.
15. MSN-_____: Composite Stair Nosing for Metal Pan Stairs
- a. Description: Extruded 6063-T-6 aluminum profile, 3 inch (76 mm) wide with 1-3/8 inch lip and 3/4 inch integrated extruded anchor.
 - b. Basis of Design: Model 8511 manufactured by American Safety Tread.
 - c. Material and Finish: Mill finish aluminum.
 - d. Abrasive:
 - 1) Material: Aluminum oxide and silicon carbide in epoxy binder.

- 2) Color: Black.
16. MSN-_____: Composite Stair Nosing for Metal Pan Stairs
 - a. Description: Extruded 6063-T-6 aluminum profile, 1-7/8 inch (48 mm) wide by 1/4 inch (6 mm) thick with 5/8 inch integrally extruded anchor.
 - b. Basis of Design: Model 9311 manufactured by American Safety Tread.
 - c. Material and Finish: Mill finish aluminum.
 - d. Abrasive:
 - 1) Material: Aluminum oxide and silicon carbide in epoxy binder.
 - 2) Color: Black.
17. MSN-_____: Composite Anti-Slip Safety Strip for Concrete Stairs
 - a. Description: Extruded aluminum profile, 2 inch (56 mm) wide with contrasting abrasive anti-slip strip to be installed 1 inch from the nose edge of the tread in poured concrete stairs.
 - b. Basis of Design: Model as manufactured by American Safety Tread.
 - c. Material and Finish: AE - Satin Anodized Aluminum.

PART 3 EXECUTION

3.1 APPLICATION

- A. Install in accordance with Manufacturer's recommendations.

END OF SECTION

SECTION 05 73 00 - DECORATIVE METAL RAILINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Railing and handrail assemblies.
 - 2. Metal railings.
- B. Related Sections:

1.3 REFERENCE STANDARDS

- A. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- B. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- C. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section. Attendees shall include, but not be limited to:
 - 1. Contractor.
 - 2. Manufacturer's representative.
 - 3. Architect.
 - 4. Owner's representative.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Submit manufacturer's product data, including description of materials, components, and finishes.
- C. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, transitions, and terminations.
- D. Samples: Submit one (1) of each item below for each type and condition shown.
 - 1. Glass: 12 inches by 12 inches (305 mm by 305 mm), showing color, thickness and edge condition.
 - 2. Railing: 12-inch (305 mm) long section of handrail showing color, finish and connection detail.
 - 3. Cladding: 6-inch by 6-inch (152 mm by 152 mm) sample of each type of cladding, showing finish.
- E. Manufacturer's qualification statement.
- F. Maintenance Data: Manufacturer's instructions for care and cleaning.
- G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than fifteen years of documented experience.

1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.

1.7 MOCK-UPS

- A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.
- B. Provide mock-up of railing system, freestanding center rail, wall-mounted handrail, smoke baffle system, and wind screen system, ____ feet (____ m) long by ____ feet (____ m) wide, indicating each type of material, cladding, and finish.
- C. Locate where directed.
- D. Mock-up may remain as part of the work.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in factory-provided protective coverings and packaging.
- B. Protect materials against damage during transit, delivery, storage, and installation at site.
- C. Inspect materials upon delivery for damage. Replace damaged items.
- D. Prior to installation, store materials and components under cover in a dry location.

1.9 FIELD CONDITIONS

- A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C).
- B. Maintain ambient temperature of space at minimum 65 degrees F (18.3 degrees C) and maximum 95 degrees F (35 degrees C) for 24 hours before, during, and after railing installation.

1.10 WARRANTY

- A. Warranty: Manufacturer's standard one-year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work:
 1. Architectural Metal Crafts, Inc.: www.archmetalcrafts.com.
 2. Big D Metalworks: www.bigdmetal.com.
 3. Hollaender Manufacturing Co.: www.hollaender.com.
 4. Livers Bronze Co.: www.liversbronze.com.
 5. VIVA Railings, LLC.: www.vivarailings.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 RAILING SYSTEMS, GENERAL

- A. Factory- or shop-fabricate to suit project conditions, for proper connection to building structure, and in largest practical sizes for delivery to site.
- B. Handrails: Comply with applicable accessibility requirements listed below:
 1. Texas Accessibility Standards (TAS).
- C. Joints: Tightly fitted and secured, machined smooth with hairline seams.
- D. Field Connections: Provide sleeves, anchors, and other devices required for site assembly and installation.
- E. Welded Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.

2.3 POST-SUPPORTED METAL RAILINGS

- A. Metal Railing: Engineered, post-supported railing system with metal or glass infill.
 - 1. Basis of Design Product:
 - a. Mirage manufactured by Livers Bronze.
 - 2. End and Intermediate Posts: Stainless steel; configuration shown on drawings.
 - 3. Top Rail and Grip Rail: Round, stainless steel, 2-inch (51 mm) diameter.
 - 4. Handrail Brackets: Same metal as railing.
 - 5. Infill: Manufacturer's perforated metal panels.
 - 6. Fasteners: Concealed.

2.4 MATERIALS AND FINISHES

2.5 ACCESSORIES

- A. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable, provide flush countersunk fasteners.
 - 1. For anchorage to concrete, provide inserts to cast into concrete for bolt anchors.
 - 2. For anchorage to masonry, provide brackets to embed in masonry for bolt anchors.
 - 3. For anchorage to stud walls, provide backing plates for bolt anchors.
 - 4. Exposed Fasteners: No exposed bolts or screws.
- B. Carbon Steel Bolts and Nuts: ASTM A307.
- C. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 0.015 inch (0.4 mm) dry film thickness per coat.
- D. Sealant: Silicone; black.
- E. Finish Touch-Up Materials: As recommended by manufacturer for field application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate and site conditions are acceptable and ready to receive work.
- B. Verify field dimensions of locations and areas to receive work.
- C. Notify Architect immediately of conditions that would prevent satisfactory installation.
- D. Do not proceed with work until detrimental conditions have been corrected.
- E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates, and supports for attachment of anchors.

3.2 PREPARATION

- A. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions, and directions for installation of anchorages and fasteners.
- B. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.3 INSTALLATION

- A. Use manufacturer's approved installer.
- B. Comply with manufacturer's drawings and written instructions.
- C. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.
- D. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

- E. Anchor securely to structure.
- F. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- G. Weld connections that cannot be shop welded due to size limitations.
 - 1. Match shop welding and bolting.
 - 2. Clean welds, bolted connections, and abraded areas.
 - 3. Touch up shop primer and factory-applied finishes.
 - 4. Repair galvanizing with galvanizing repair paint in accordance with ASTM A780/A780M.
- H. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, noncumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

3.5 FIELD QUALITY CONTROL

- A. Field Services: Provide the services of the manufacturer for field observation of installation of railings.

3.6 CLEANING

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements.
- B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage the material or finish.

3.7 PROTECTION

- A. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
 - 1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

SECTION 05 77 00 - DECORATIVE EXTRUDED METAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Edge-protection and transition profiles for floors.
 - 2. Finishing and edge-protection profiles for walls and countertops.
 - 3. Decorative corner trim.
 - 4. Decorative reveals.
 - 5. Mirror trim.
- B. Related Sections:
 - 1. Section 09 21 16 - Gypsum Board Assemblies.

1.3 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Warranty.
- C. Verification Samples: For each finish product specified, minimum size 6 inches (305 mm) square, representing actual product in color and texture.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - 1. Package for protection against transportation damage.
 - 2. Provide markings to identify components consistently with drawings.
- B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - 1. Store in well-ventilated space out of direct sunlight.
 - 2. Protect from moisture and condensation.
 - 3. Avoid contact with other materials that might cause staining, denting, or other surface damage.

1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.

1. C.R. Laurence Co., Inc.: www.crlaurence.com/#sle.
 2. Fry Reglet Corporation: www.fryreglet.com/#sle.
 3. Genesis APS International: www.genesis-gs.com/#sle.
 4. Schluter Systems: www.schluter.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 EDGE-PROTECTION AND TRANSITION PROFILES FOR FLOORS

- A. Flooring Transition, Type 1 (MT-1):
1. Basis of Design Product: Schluter®-RENO-RAMP.
 2. Description: anodized aluminum profile with textured, sloped exposed surface, tapered leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 3. Material and Finish: AE - Satin Anodized Aluminum.
 4. Height: Height as required.
 5. Ramp Length: As required to maintain a slope not greater than one unit vertically in two units horizontally.
- B. Flooring Transition, Type 2 (MT-2):
1. Basis of Design Product: Schluter®-RENO-T.
 2. Description: T-shaped profile with 1/16 inch (1 mm) thick beveled exposed surface and 11/32 inch (9 mm) tall integrated vertical anchoring leg.
 3. Material and Finish: E - Stainless Steel Type 304 = V2A.
 4. Width: 17/32 inch.
- C. Flooring Transition, Type 3 (MT-3):
1. Basis of Design Product: Schluter®-RENO-TK.
 2. Description: profile with sloped exposed surface, 1/4" (6 mm) deep channel below exposed surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 3. Anchoring Leg: Provide with straight or special radius anchoring leg, as required.
 4. Material and Finish: E - Stainless Steel Type 304 = V2A.
 5. Height: Height as required.
- D. Flooring Transition, Type 4 (MT-4):
1. Basis of Design Product: Schluter®-RENO-U.
 2. Description: profile with sloped exposed surface, 5/32" (4 mm) tall leading edge, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 3. Material and Finish: E - Stainless Steel Type 304 = V2A.
 4. Height: Height as required.

2.3 FINISHING AND EDGE-PROTECTION PROFILES FOR WALLS AND COUNTERTOPS

- A. Decorative Trim, Type 1 (DT-1):
1. Basis of Design Product: Schluter®-DECO.
 2. Description: Profile with 1/4 inch (6 mm) wide visible surface and integrated trapezoid-perforated anchoring leg.
 3. Anchoring Leg: Provide with straight or special radius anchoring leg as required.
 4. Material and Finish: E - Stainless Steel Type 304 = V2A.
 5. Height: Height as required.
- B. Decorative Trim, Type 3 (DT-3):
1. Basis of Design Product: Schluter®-QUADEC.

2. Description: profile with square visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 3. Corners: Provide with matching inside corners and internal connectors.
 4. Material and Finish: E - Stainless Steel Type 304 = V2A.
 5. Height: Height as required.
- C. Decorative Trim, Type 4 (DT-4):
1. Basis of Design Product: Schluter®-SCHIENE.
 2. Description: L-shaped profile with 1/8" (3.2) wide top section and vertical wall section that together form the visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 3. Anchoring Leg: Provide with straight or special radius anchoring leg as required.
 4. Material and Finish: E - Stainless Steel Type 304 = V2A.
 5. Height: Height as required.
- D. Decorative Trim, Type 5 (DT-5):
1. Basis of Design Product: Fry Reglet "J" Molding.
 2. Description: "J" shaped trim for use at the perimeter of panel materials.
 3. Size:
 - a. Depth: 5/8 inch.
 - b. Return: 3/16 inch.
 4. Material: Aluminum.
 5. Finish: Mill.

2.4 DECORATIVE CORNER TRIM

- A. Corner Trim, Type 1 (CT-1):
1. Basis of Design Product: Fry Reglet®-DMCT-375.
 2. Description: Corner trim with 3/8" exposure on each side.
 3. Material and Finish: As selected by the Architect.

2.5 DECORATIVE REVEALS

- A. Decorative Reveal, Base Type (DR-B):
1. Basis of Design Product: Fry Reglet® DRMB-625-250, Non-Vented.
 2. Description: Decorative base reveal.
 - a. Reveal Depth: 3/8 inch..
 - b. Reveal Width: 2-1/2 inches.
 3. Material: Aluminum.
 - a. Finish: Clear anodized.

2.6 MIRROR TRIM

- A. Mirror Trim (MRT):
1. Basis of Design Product: Model DV606 manufactured by C.R. Laurence Co., Inc.
 2. Description: J-Trim with chamfered edge for use as mirror frame.
 3. Depth: 1/4 inch, verify with mirror glass thickness.
 4. Material: Aluminum.
 5. Finish: Satin Anodized.

2.7 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221/ASTM B221M, Alloy 6063-T5/T52.

PART 3 EXECUTION

3.1 APPLICATION

- A. Consult manufacturer's current technical literature for proper design and installation instructions.

END OF SECTION

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes rough carpentry, light hardware, and miscellaneous items of work not included in another Section. This Section also includes:
 - 1. Structural wood supports, grounds, backing, and blocking required for millwork and casework items that are an integral part of wall, floor, and/or ceiling construction.
 - 2. Plywood sheathing.
- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories.
 - 2. Section 03 30 00 - Cast-In-Place Concrete.
 - 3. Section 07 21 00 - Thermal Insulation.
 - 4. Section 07 92 00 - Joint Sealants.
 - 5. Section 09 21 16 - Gypsum Board Assemblies.
 - 6. Section 09 24 00 - Cement Plastering.
 - 7. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

1.3 REFERENCE STANDARDS

- A. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- B. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; 2018.

1.4 QUALITY ASSURANCE

- A. Lumber and plywood shall be grade or quality marked by WWPA, WCLIB, APA, AWPB, or by other grading and inspection agencies acceptable to Architect. Grade marks shall include the designation "S-DRY"(or "MC-15" as applies) where applicable. Grade and quality marks shall not be apparent on surfaces exposed in the finished work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store kiln dried materials in enclosed areas, protected from moisture and separated from contact with concrete or soil.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Temporary Construction: Clean lumber at Contractor's option, rough or smooth, as usage requires.
- B. Lumber Not Otherwise Specified or Noted:
 - 1. Douglas fir or larch, graded and grademarked, according to Reference Standard 1.02 A or B, #1 grade:
 - a. Boards: Construction grade.
- C. Plywood for Walls and Roofs; as Indicated on Drawings:
 - 1. Unless glue type is otherwise specified, exterior plywood, interior plywood exposed to continuing moisture, and pressure treated plywood shall be fabricated with exterior glue. Plywood with interior glue shall be fully protected from soaking or continuing moisture at all times.
- D. Rough Hardware:

1. Nails, spikes, bolts, screws, tacks, and framing connectors of standard manufacture as required. Hot dip galvanize items exposed to moisture or to exterior and those items that are in contact with wood pressure treated with waterborne salts:
 - a. Bolts and Nuts: ASTM A307, Grade A.
 - b. Lag Bolts: Fed. Spec. FF-B-561. Pre-drill per CBC.
 - c. Nails: Fed. Spec. FF-N-101, common unless otherwise noted or specified.
 - d. Joist Hangers and Framing Connectors: Simpson or approved equal, unless otherwise noted.
 - e. Power Driven Fasteners: Hilti, Ramset, or approved equal, each use and fastener type subject to prior approval of Architect.
- E. Pressure Treatment (Decay and Termite Prevention):
 1. Pressure treat for decay and termite prevention, Douglas fir or larch wood materials that are embedded in or set against concrete.
 2. Treat in accordance with Reference Standard 1.02 E and quality mark as per Reference Standard 1.02 F.
 3. Treat with any of the following processes at Contractor option. Creosote type preservatives are not permitted:
 - a. Penta in an LPG carrier (Cellon) or Penta in Hydrocarbon Solvent-Type D (Dow Process) AWPB LP-4 quality marked.
 - b. Ammoniacal copper arsenate (ACA) or chromated copper arsenate (CCA) in a water carrier (AWPB LP-2 quality marked).
 - c. Disodium Octaborate Tetrahydrate (DOT) such as Advance Guard/Hi-bor by Osmose, Inc.
 - d. Members treated with waterborne salts shall be dried to a moisture content not exceeding 19 percent after treatment.
 4. Where possible, precut material before treatment.
 5. Holes and cutoffs and handling and storage shall be in accordance with AWPA M-4.
 6. Ensure that ferrous metal fastenings and items in contact with wood treated with waterborne salts are hot dip galvanized (1.25 oz. coating) where required by ICC reports.
- F. Framing Connectors: Simpson Strong Tie Corp., or equal.

2.2 MOISTURE CONTENT

- A. 19 percent maximum for two times thickness and less; 19 percent maximum for thickness greater than two times and less than four times; and 22 percent maximum for thickness greater than four times.

2.3 SIZES

- A. Surfaced to "DRY" sizes. Sizes noted are nominal unless shown as net.

2.4 SURFACING

- A. All wood materials exposed in the finished work shall have re-sawn surfaces of clean natural color unless noted or specified otherwise. Concealed framing lumber shall be S4S.

PART 3 EXECUTION

3.1 ERECTION AND INSTALLATION

- A. Framing:
 1. Properly lay out framing with pieces closely fitted, accurately plumbed, leveled and aligned, and rigidly secured in place.
- B. Except as specifically shown on structural drawings, cutting of all wood, etc. is limited to those cuts permitted by CBC.
- C. Bridging and Blocking:

1. Provide two times blocking at intersections of finished surfaces for adequate bearing and at points where required to support fixtures, cabinets, hardware, and other equipment mounted on walls.
- D. Plywood (General): Unless more stringent requirements are indicated on the Drawings or required by code, application of plywood shall be in accordance with recommendations of the American Plywood Association.
- E. Connections and Fastenings:
1. For bolted connections, provide washers under heads and nuts bearing on wood, and draw nuts tight. Retighten before closing in framing.
 2. Exercise care in nailing through exposed sheathing and siding and ensure that fasteners penetrate into framing members

END OF SECTION

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SECTION 06 16 00 - SHEATHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 - 1. Wall sheathing.
 - 2. Underlayment.
 - 3. Sheathing joint and penetration treatment.
 - 4. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- C. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board; 2020.
- D. ASTM C834 - Standard Specification for Latex Sealants; 2017.
- E. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2020.
- F. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- G. ASTM D1037 - Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials; 2012 (Reapproved 2020).
- H. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).
- I. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- K. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- L. ASTM F1667/F1667M - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples; 2021a.
- M. AWPA U1 - Use Category System: User Specification for Treated Wood; 2018.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Technical data for each type of process and factory fabricated product. Indicate component materials and dimensions and include construction and application details:
 - a. Include data for wood preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
 - b. Include data for fire retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.

- c. For fire retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
- d. For products receiving a waterborne treatment, include statement that moisture content of treated materials reduced to levels specified before shipment to Project site.
- e. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 QUALITY ASSURANCE

- A. Fire Test Response Characteristics:
 - 1. For assemblies with fire resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Fire resistance ratings: Indicated by design designations from UL Fire Resistance Directory or GA-600 Fire Resistance Design Manual.
- B. Testing Agency Qualifications: For testing agency providing classification marking for fire retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Plywood: DOC PS 1.
- B. Oriented Strand Board: DOC PS 2.
- C. Thickness: As necessary to comply with requirements specified, but not less than thickness indicated.
- D. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process - AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground:
 - 1. Preservative chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE RETARDANT TREATED PLYWOOD

- A. Where fire retardant treated materials are indicated, use materials complying with requirements acceptable to authorities having jurisdiction and with fire test response characteristics specified determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire Retardant Treated Plywood by Pressure Process:
 - 1. Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an

additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test:

- a. Use treatment that does not promote corrosion of metal fasteners.
 - b. Exterior type: Treated materials shall comply with requirements specified above for fire retardant treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
 - c. Design value adjustment factors: Treated lumber plywood shall be tested according to ASTM D5516 and design value adjustment factors shall be calculated according to ASTM D6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high temperature fire retardant treatment is indicated, span ratings for temperatures up to 170 degrees F (76 degrees C) shall be not less than span ratings specified.
- C. Kiln dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire retardant treated plywood with appropriate classification marking of qualified testing agency.
- E. Application:
1. Treat plywood indicated on Drawings and the following:
 - a. Roof and wall sheathing within 48 inches (1,220 mm) of fire walls.
 - b. Subflooring and underlayment for raised platforms.

2.4 WALL SHEATHING

- A. Glass Mat Gypsum Wall Sheathing - ASTM C1177/C1177M:
1. Product is subject to compliance with requirements; provide products by one of the following:
 - a. CertainTeed Corporation: GlasRoc (basis of design).
 - b. Georgia Pacific: Dens-Glass.
 - c. National Gypsum Company: Gold Bond eXP.
 - d. United States Gypsum Co.: Securock.
 2. Type and Thickness: Regular, 1/2 inch (12.7 mm) thick.
 3. Size: Four feet by eight feet (1,220 mm by 2,440 mm) for vertical installation.

2.5 SUBFLOORING AND UNDERLAYMENT

- A. Plywood Combination Subfloor Underlayment - DOC PS 1, Exterior, Structural I, C-C Plugged Single Floor Panels:
1. Span rating: Not less than 20 o.c.
 2. Nominal thickness: Not less than one inch (25 mm).
 3. Edge detail: Tongue and groove.
 4. Surface finish: Fully sanded face.
- B. Underlayment: Provide underlayment in nominal thickness not less than 1/4 inch (6.4 mm) over smooth subfloors and not less than 3/8 inch (9.5 mm) over board or uneven subfloors.
- C. Sound Deadening Board - Class C Fire Rated, Molded, Recycled Post-Consumer Paper, Cellulose Fiber Structural Panel:
1. Density: 26 pcf to 28 pcf (416 = 448 kg/cu.m) tested in accordance with ASTM C209.
 2. Tensile strength - when tested in accordance with ASTM C209:
 - a. Parallel: 450 - 700 psi (3,100 - 4,830 kPa).
 - b. Transverse: 750 - 1,000 psi (5.1171 - 6.894 kPa).
 3. Hardness (Janka Ball): 230 pounds (104 kg) tested in accordance with ASTM D1037.
 4. Water absorption by volume, when tested in accordance with ASTM C209:
 - a. Two-hour immersion: Maximum seven percent (7%).

5. Expansion: 50 percent to 90 percent relative humidity, 0.25 percent in accordance with ASTM C209.
6. Noise reduction coefficient (NCR): 0.20.
7. Flame spread: Maximum 75 tested in accordance with ASTM E84 Class C.
8. Thickness: 3/4 inch (19 mm).

2.6 FASTENERS

- A. Provide fasteners of size and type indicated that comply with requirements specified for material and manufacture. Provide fasteners with hot dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667/F1667M.
- C. Power Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening Gypsum Sheathing to Cold Formed Metal Framing:
 1. Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic polymer or corrosion protective coating having salt spray resistance of more than 800 hours according to ASTM B117:
 - a. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.

2.7 SHEATHING JOINT AND PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass Mat Gypsum Sheathing:
 1. Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass fiber sheathing tape and for covering exposed fasteners:
 - a. Sheathing tape: Self-adhering glass fiber tape, minimum two inches (50 mm) wide, ten by ten or ten by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass mat gypsum sheathing and with history of successful in-service use.

2.8 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three (3) support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and roof sheathing installation with flashing and joint sealant installation so materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions. Fasten gypsum sheathing to cold formed metal framing with screws. Install boards with a 3/8-inch (9.5 mm) gap where non-load bearing construction abuts structural elements. Install boards with a 1/4-inch (6.4 mm) gap where they abut masonry or similar materials that retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Vertical Installation:
 - 1. Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud:
 - a. Space fasteners approximately eight inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.
- D. Seal sheathing joints according to sheathing manufacturer's written instructions. Apply glass fiber sheathing tape to glass mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal penetrations and openings.

3.3 PATCHING

- A. Refer to Section 07 26 27 - Fluid-Applied Air Barrier for criteria regarding repair of damaged sheathing in preparation for application of air barrier system.

END OF SECTION

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SECTION 06 20 00 - FINISH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
1. Providing all finish carpentry items including, but not limited to:
 - a. Finish carpentry.
 - b. Millwork and cabinetry.
 - c. Plastic laminate.
 - d. Casework hardware.
 - e. Miscellaneous millwork.
 2. Installation of:
 - a. Finish hardware.
 - b. Plastic laminate faced wood doors.
- B. Related Sections:
1. Section 06 10 00 - Rough Carpentry.
 2. Section 13 34 23.14 - Fabricated Classroom Buildings.

1.3 REFERENCE STANDARDS

- A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- B. BHMA A156.9 - Cabinet Hardware; 2020.
- C. American National Standards Institute:
1. ANSI A156.9 Cabinet Hardware.
 2. ANSI A161.1 Woodwork Testing Standards.
 3. ANSI A208.1 Mat-Formed Wood Particleboard.
- D. Woodwork Institute:
1. WI North American Architectural Woodwork Standards (current edition).
- E. National Electrical Manufacturers Association:
1. NEMA LD 3 High Pressure Decorative Laminates.

1.4 SUBMITTALS

- A. Product Data:
1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 2. Manufacturer's preprinted product information for all hardware proposed on the Project.
 3. Manufacturer's preprinted maintenance instructions for the casework hardware.
- B. Shop Drawings:
1. Indicate size, material, and finish.
 2. Show locations and installation procedures, including hardware, sinks, service fixtures, trim, and other pertinent data for each unit.
- C. Certification: Provide manufacturer's certification that casework has been fabricated and installed according to WI "Custom" Grade guidelines or better.
- D. Samples: Two (2) each, 6 inch by 6 inch by 3/4 inch sample of specified particleboard core with grade stamp for use as verification of installed product.
- E. Closeout:
1. Record drawings: Indicate revisions to original Drawings and shop drawings.

2. Manufacturer contact names, addresses, and phone numbers.
3. Finish material schedule: Names and color numbers of laminates and stains.
4. Keys: Provide additional master key for each room and additional locksets totaling one percent (1%) of total Project for attic stock.

1.5 PERFORMANCE REQUIREMENTS

- A. Unless otherwise indicated, perform work in accordance with WI "Architectural Woodwork Standards," Custom Grade, except where specification exceeds those standards the more stringent shall govern.
- B. Fabricate millwork and cabinetry in accordance with ANSI A161.1, NEMA LD3, and general static load testing performed and certified by an independent testing agency covering the following areas of product performance, with these minimum results:
 1. Base cabinet construction/racking test: 800 pounds.
 2. Cabinet front joint loading test: 425 pounds.
 3. Wall cabinet static load test: 2,000 pounds.
 4. Drawer front joint loading test: 600 pounds.
 5. Drawer construction/static load test: 750 pounds.
 6. Cabinet adjustable shelf support device/static load test: 300 pounds.
- C. Shelf Loading: Comply with loading/deflection standards of the Composite Panel Association.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a licensee of WI's Certified Compliance Program.
- B. Installer Qualifications: Licensee of WI's Certified Compliance Program.
- C. Quality Standard:
 1. Unless otherwise indicated, comply with WI's "Manual of Millwork" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements:
 - a. Before delivery to jobsite, millwork supplier:
 - 1) Licensees of WI shall issue a certified compliance certificate indicating millwork products being furnished for this Project, and certifying that these products and their installation, will fully meet requirements of grade or grades specified.
 - 2) Non-licensees of WI shall provide evidence that they have arranged for inspection by WI inspector after completion of fabrication and installation. If conditions are found to be compliant, inspector will issue Compliance Certificate indicating millwork products being furnished for this Project and certifying that these products and their installation will fully meet requirements of grade or grades specified.
 - b. Each elevation of casework and each countertop shall bear certified compliance label.
 - c. Cabinet Design Series (CDS): CDS numbers on Drawings indicate typical designs.
- D. Certified Seismic Installation Program (CSIP):
 1. Before wood or metal stud walls are closed up, provide a written Woodwork Institute CSIP report confirming that acceptable backing is provided in all locations required for casework installation or identifying those locations where backing is missing or improperly located:
 - a. Backing shall consist of a minimum of either three by six (3 x 6) flat Douglas Fir or 16-gage 50 KSI sheet metal.
 2. On completion of installation, provide a Woodwork Institute CSIP Certificate identifying the work covered and certifying that installation meets the requirements of the WI CSIP attachment details and schedules.

3. All fees charged by the Woodwork Institute for their CSIP are the responsibility of the millwork installer and shall be included in their bid.

E. Pre-Installation Conference:

1. See Section 01 31 00 - Project Management and Coordination.

1.7 WARRANTY

- A. Warranty the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include but not be limited to the following:
 1. Rough or difficult operation, or loose or missing parts.
 2. Delamination of surfaces.
 3. Noticeable deterioration of finish.
 4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver completed laminate clad casework, countertops, and related products only after wet operations in building are completed. Store in ventilated place, protected from the weather, with relative humidity range of 20 to 50 percent.
- B. Protect finished surfaces from soiling and damage during handling and installation with a protective covering.

PART 2 PRODUCTS

2.1 MILLWORK MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work. Manufacturers and fabricators must be Woodwork Institute listed Accredited Millwork Companies, current roster.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 MILLWORK MATERIALS

- A. Plastic Laminate:
 1. Acceptable Manufacturers:
 - a. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1) Abet Laminati: abetlaminati.com/#sle.
 - 2) Formica: www.formica.com/#sle.
 - 3) Panolam: panolam.com/hpl-high-pressure-laminate/#sle.
 - 4) Wilsonart: www.wilsonart.com/#sle.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 2. High-pressure decorative laminate complying with NEMA LD3, and the following requirements:
 - a. PL-1: Plastic Laminate Cabinets.
 - 1) Manufacturer: Wilsonart.
 - 2) Color: Platinum D315-60.
 - 3) Finish: Matte.
 - 4) Location: As indicated on Drawings.

- b. PL-2: Plastic Laminate Accent.
 - 1) Manufacturer: Wilsonart.
 - 2) Color: Atlantis D25-60.
 - 3) Finish: Matte.
 - 4) Location: As indicated on Drawings.
 - c. PL-3: Plastic Laminate Green Room.
 - 1) Manufacturer: Wilsonart.
 - 2) Color: Williamsburg Cherry 7936K-07.
 - 3) Finish: Textured gloss finish with Aeon.
 - 4) Location: As indicated on Drawings.
 - d. If laminate has wood grain, direction of grain shall be vertical on door, end panels, fascia panels, and exposed backs; horizontal on drawer faces, aprons, and top rails.
3. Laminate Grades:
- a. Exposed doors, finished end panels, and other vertical surfaces: GP28 (0.028 inch thick nominal)
 - b. Horizontal surfaces other than top: GP28 (0.028 inch thick nominal)
 - c. Cabinet Liner: CL20 (0.020-inch nominal), white.
 - d. Work surfaces and countertops: GP50 (0.050-inch thick nominal) with BK20 (0.20-inch thick) backer sheet.
 - e. Backsplash: PH42 (0.042 inch nominal) with nominally balanced backer sheet.
4. Adhesive: PVA water resistant adhesive. Contact adhesives not permitted.
5. Pressure Fused Laminate:
- a. NEMA LD3 VGL, and NEMA LD3 CLS, melamine resin impregnated, 120-gram PSM minimum, thermofused to core under pressure.
 - b. Color:
 - 1) Closed interiors, underside of wall cabinets: White.
 - 2) Exposed and semi-exposed open cabinets: Match exterior.
 - c. Provide balanced construction with same thermofused melamine. Unsurfaced coreboard or simple backers not allowed.
- B. Core Material:
- 1. Particleboard: ANSI 208.1, Grade M-2-Exterior Glue.
 - 2. Medium-density fiberboard: ANSI A208.2, Grade MD.
 - 3. Plywood: Shop sanded, exterior grade veneer cored, hardwood faced, any species, with no defects affecting strength or utility. Overlay plywood not permitted. Plywood allowed at countertops and toe-base only.
 - 4. Water resistant treated plywood shall have 24-hour thickness swell factor of five percent (5%) or less and 24-hour water absorption factor of ten percent (10%) or less; P.S. 51, Type II or better.
 - 5. Cabinet components shall be of the following minimum core thicknesses:
 - a. Cabinet backs, drawer body, and drawer bottoms: 1/2-inch particleboard.
 - b. Door and drawer face, base, wall, and tall cabinet tops and bottoms, cabinet sides, drawer spreaders, cabinet back rear hangstrips, structural dividers, and exposed cabinet backs: 3/4 inch particleboard.
 - c. Work surfaces and countertops: Minimum 1 inch particleboard or plywood, except use water resistant treated plywood core at counters with sinks.
 - d. Shelves: 3/4 inch particleboard core for 30 inches long or less, 1 inch thick particleboard core for more than 30 inches long; 14-inch deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches long.
 - e. Cabinet toe-base: 3/4 inch plywood. No particleboard within 3 inches of floor.
- C. Countertops:
- 1. Refer to Section 12 36 00 - Countertops.

- D. Toe Spaces:
 - 1. Leave toe spaces unfinished for installation of resilient base, unless otherwise shown.
- E. End Panels and Filler Strips:
 - 1. Match adjacent case-piece.
- F. Edging:
 - 1. Provide the following in accordance with "Edging Locations:"
 - a. Flat edge PVC: 0.020 inch. Solid, high-impact, purified, color-thru, acid resistant, machine-applied with hot melt adhesives.
 - b. Three-millimeter (3 mm) PVC: Solid, high-impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, and machine profiled to 1/8-inch radius.
 - 2. Edging Locations:
 - a. Cabinet body edge, including door/drawer front spacer rail: Flat edge PVC, color matched to door/drawer face or as selected.
 - b. Forward edge of interior body components, interior dividers, shelf, and top edges of drawer body: Flat edge PVC to match cabinet interior surface color.
 - c. Door/drawer-front edging: Three-millimeter (3 mm) PVC, color matched to standard laminates.

2.3 CABINET HARDWARE

- A. All hardware shall meet ANSI A156.9 and shall be subject to approval by the Architect. All keying shall match existing master key system and be approved by the Owner:
 - 1. Acceptable manufacturers:
 - a. Knap & Vogt.
 - b. As specified herein, provide specified product, or Architect approved equal.
- B. Hinges:
 - 1. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, self-closing.
 - a. Provide 170 degree minimum opening capabilities. For end doors perpendicular to walls, provide 90 degree type.
 - b. For doors 32 inches high or less, provide 2 pair of hinges, add 1/2 pair for every additional 20 inches.
 - c. Products: Subject to compliance with requirements, provide one of the following:
 - 1) No. 326.05 manufactured by Hafele North America Co.
 - 2) No. B71650 manufactured by Julius Blum, Inc.
 - 3) No. MD61-253-Z00 manufactured by Mepla-Alfit, Inc.
 - 2. One pair per door to 48 inches height. One and one-half pair over 48 inches in height. Hinge shall accommodate 13/16 thick laminated door and allow 270-degree swing.
 - 3. Finish: US26D.
- C. Pulls:
 - 1. Basis-of-Design: Model DP3 Series by Dough Mockett & Company:
 - a. Pull design, four inches (4"), satin chrome.
- D. Sliding Door Hardware:
 - 1. Frameless 1/4-inch glass sliding doors; double track rolling door assembly.
 - 2. Framed 13/16-inch thick stile and rail sliding doors; top mounted track with dual roller hangers. Vertical adjustment for accurate alignment.
- E. Drawer Slides:
 - 1. Standard drawers: 3/4 extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 100-pound dynamic load rating at full extension.
 - 2. File drawers: Full extension, three-part progressive opening slide, precision steel ball bearing, minimum 100-pound dynamic load rating at full extension, zinc plated or epoxy

- coated at manufacturer's option.
- 3. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not permitted.
- 4. Paper storage drawers: Full extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 150-pound dynamic load rating at full extension.
- F. Catches:
 - 1. Provide opening resistance in compliance with the Americans with Disabilities Act:
 - a. Provide top-mounted magnetic catch for base and wall cabinet door.
 - b. Provide two (2) at each tall cabinet door. Catch housing shall be molded in White.
- G. Adjustable Shelf Supports:
 - 1. Dual-pin design with anti-tip-up shelf restraints for both 3/4 inch and 1 inch shelves.
 - 2. Include keel to retard shelf slide-off, and slot for mechanical attachment of shelf to clip.
 - 3. Load rating shall be minimum 300 pounds each support without failure.
 - 4. Basis of Design: Products manufactured by Knappe and Vogt.
 - a. Standard: Model 255 Steel.
 - b. Supports: Model 256.
- H. Wardrobe Rod: 1-1/6 inch diameter plated steel rod, with captive sockets.
- I. Coat Hooks: Single and double prong, wall mount - satin aluminum.
- J. Locks: Five-disk tumbler cam-style with strike. Locks on cabinets in same room keyed alike. Provide two (2) keys per room where doors and drawers are scheduled to receive locks. Dull chrome finish. Lock core shall be removable with a control key, permitting Owner to change lock arrangements without tools.

2.4 SPECIALTY ITEMS

- A. Grommets:
 - 1. Approved Product/Manufacturer: Model No. EDP3 manufactured by Doug Mockett & Company, Inc. (basis of design), Manhattan Beach, CA; (800) 523-1269, or Architect approved equal.
 - 2. Size: 2-1/2 inches diameter with "Flip-Top"™ tab in cap.
 - 3. Colors: As selected by Architect from manufacturer's available colors.
 - 4. Number/location: Where electrical, telephone, and computer data wiring need to pass through tops whether shown or not.
- B. Keyboard Drawers (at all knee spaces):
 - 1. Approved product/manufacturer: No. SD-1 as manufactured by Knappe & Vogt; or Architect approved equal.
- C. Molded Personal Pencil Drawer: High-impact 100 Polystyrene with in-stop, out-stop, and self-closing features. Provide under top mounted 100-pound self-closing slides. Twelve (12) compartment drawer body, and slides, black. Provide where indicated on plans.

2.5 SOLID STOCK

- A. Moisture Content: Percent of moisture in relation to over-dry weight shall be between eight percent (8%) and 13 percent at time of installation.

2.6 MISCELLANEOUS

- A. Utility Shelving: WI "Economy" grade.
- B. Clothes Rod: 1-1/2 inch diameter smooth wooden dowel by length required, with end supports and fasteners of type recommended to suit application.
- C. Telephone/MDF/IDF Board: Provide minimum four foot by eight foot by 3/4 inch (4' x 8' x 3/4") thick plywood for telephone/data punch down blocks and video equipment in accordance with

Section 06 10 00: Rough Carpentry. Paint in accordance with Section 09 90 00: Painting and Coating.

2.7 MILLWORK FABRICATION

- A. Use the WI Custom Grade woodwork classification unless noted elsewhere complying with referenced quality standard.
- B. Fabricate casework, countertops, and related products to dimensions, profiles, and details shown on Drawings. Fabricate casework square, plumb, and true.
- C. Detailed Requirements for Cabinet Construction:
 - 1. Toe-Base:
 - a. Continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor.
 - b. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch from face of finished end for flush installation of finished base material.
 - c. No cabinet sides-to-floor will be allowed.
 - 2. Cabinet Top and Bottom:
 - a. Solid sub-top shall be furnished for all base and tall cabinets.
 - b. At cabinets over 36 inches, bottoms and tops shall be mechanically joined by a fixed divider.
 - c. Assembly devices shall be concealed on bottom side of wall cabinets.
 - 3. Cabinet Sides:
 - a. Doweled, and glued under pressure, or attached with fully concealed interlocking mechanical fasteners to sub-top and bottom.
 - b. Drill holes for adjustable shelves 1-1/4 inch on center.
 - 4. Cabinet Backs:
 - a. Side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom.
 - b. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two (2) at base, two (2) at wall, and three (3) at tall cabinets as instructed by casework manufacturer.
 - c. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on Drawings.
 - 5. Exposed end corner and face frame attachment:
 - a. Butt joint, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
 - 6. Door and Drawer Fronts:
 - a. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
 - b. Where indicated, provide stile and rail doors with full 1/4 inch plate glass, hinged or sliding. Exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.
 - c. Where indicated, frameless sliding glass doors shall be 1/4 inch thick plate glass with ground and polished edges. Fit with anodized aluminum shoes and nylon rollers.
- D. Drawers:
 - 1. Drawer fronts: Apply to separate drawer body component sub-front.
 - 2. Drawer sides: Doweled to receive front and back, glued under pressure, machine squared.
 - 3. Drawer bottom: Set into front and sides, 1/4 inch deep groove with minimum 3/8 inch standing shoulder, continuously glued. Reinforce drawer bottoms with 1/2 inch by 4 inch front-to-back intermediate underbody stiffeners, mechanically fastened. One (1) at 24 inches, two (2) at 36 inches, and over.

4. Paper Storage Drawers: Fitted with full width hood at back.
 5. Hanging file drawers shall be fabricated to accept letter size hanging folders compatible with Pendaflex system.
- E. Vertical and Horizontal Dividers: As required by manufacturer for type and style of component.
- F. Door/Drawer Front Rail: As required by manufacturer for type and style of component, and hardware placement.
- G. Typical Desk or Counter Height at Knee Space Locations: 30 inches A.F.F.

PART 3 EXECUTION

3.1 JOB CONDITIONS

- A. Environmental Requirements:
1. Do not install casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least one (1) week:
 - a. Manufacturer/supplier shall advise Contractor of temperature and humidity requirements for architectural casework installation areas.
 - b. After installation, control temperature and humidity to maintain relative humidity between 25 and 55 percent.
- B. Conditions: Do not store or install casework in building until concrete, masonry, and drywall/plaster work is dry.

3.2 COORDINATION

- A. Coordinate the work of this Section with plumbing work specified in Division 22. Coordinate sink opening construction with sinks specified in Division 22 or as indicated on Drawings.
- B. Coordinate location of blocking in walls for installation and support of wall cabinets.

3.3 MILLWORK INSTALLATION

- A. Positioning: Place approximately level, plumb, and at right angles to adjacent work.
- B. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging the products and adjacent work.
- C. Anchorage: Attach securely so the products will perform to their maximum ability without damage from inadequate fastenings.
- D. Fasten tops to frames with concealed clips, screws, and glue.
- E. Install simulated wood trim in locations shown on Drawings and in accordance with manufacturer's instructions.

3.4 EXISTING DOOR LAMINATE RESURFACING

- A. Resurfacing procedures shall be in accordance with the recommendations and instructions of the laminate and adhesive manufacturers.
- B. Acclimate laminate to the same environment as existing material at least 48 hours. Perform work in well-ventilated area, out of the way of construction dust and traffic to maintain clean adhesion.
- C. Clean the substrate with detergent or non-flammable solvent as instructed by laminate manufacturer to remove wax, grease, and polish deposits.
- D. Using a belt sander or sander instructed by manufacturer, sand entire surface to remove original finish. Remove sanding dust thoroughly.
- E. Coat the sanded surface and back of laminate with a uniform coating of contact adhesive. Allow to dry thoroughly prior to assembling. Assembling wet adhesive lines will trap solvent and may result in poor bonding. Follow the adhesive manufacturer's instructions.
- F. Index the laminate with the substrate. Make initial contact by smoothing with palms. Apply pressure using a "J" roller or rotary press. Allow to set as instructed by adhesive manufacturer

to achieve full adhesion to maintain warranty. Trim with recommended tools.

- G. Apply laminate to door faces and exposed vertical edges. Apply edges before face. Paint top and bottom edges to color match facing.
- H. Coordinate hardware and vision lite cutouts with work of other Sections.

3.5 FINISH HARDWARE INSTALLATION

- A. The supplier will mark each item of hardware for location. Protect the markings until each item is installed. If any item is delivered to the job not properly marked, return it to the supplier for marking before attempting to install it.
- B. Check markings on hardware for proper location. Install and make necessary adjustments for proper working order. Any hardware damaged by improper adjustment or careless abuse will be replaced by Contractor at his expense.
- C. Provide clean, properly sized, and accurately placed mortises and drilled holes for all mortise hardware such as locksets and for cylindrical locks where specified only.
- D. Fit all surface-applied hardware accurately.
- E. After hardware is installed, protect exposed surfaces by use of heavy paper and masking tape and maintain until job completion.
- F. Remove all finish hardware except that which is primed for painting before painter's finish is applied. Permanently replace and re-adjust for proper function after painter's finish has dried hard.
- G. Millwork Contractor shall be responsible for hardware on millwork.

3.6 PLASTIC LAMINATE FACED WOOD DOOR INSTALLATION

- A. Protect all doors during handling.
- B. Install doors in accordance with manufacturer's instructions.
- C. Install and adjust doors for smooth, quiet operation.
- D. Refer to Section 08 81 00 - Door Hardware where applicable.

END OF SECTION

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SECTION 06 83 16 - FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 - 1. Glass fiber reinforced plastic paneling (FRP).
 - 2. Trim accessories.
 - 3. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 06 10 00: Rough Carpentry.
 - 2. Section 07 92 00: Joint Sealants.
 - 3. Section 09 21 16: Gypsum Board Assemblies.

1.3 REFERENCE STANDARDS

- A. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.4 SUBMITTALS

- A. Product Data: Technical data including supporting documentation of compliance with surface burning characteristics for FRP and accessories.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Building Code: Comply with applicable requirements of the 2019 CBC for interior plastic materials and interior wall finishes.
 - 2. Surface burning characteristics:
 - a. Determined by testing identical products according to ASTM E84 by qualified testing agency. Identify products with appropriate markings of applicable testing agency:
 - 1) Flame spread index: 25 or less.
 - 2) Smoke developed index: 450 or less.
- B. Source Limitations: Obtain FRP and trim accessories from single manufacturer.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Glass Fiber Reinforced Plastic Paneling:
 - 1. Gelcoat finished, glass fiber reinforced plastic panels complying with ASTM D5319:
 - a. Provide USDA accepted panels for incidental food contact.
 - b. Manufacturers are subject to compliance with requirements; provide products by one of the following:
 - 1) Crane Composites, Inc.
 - 2) Glasteel.
 - 3) Marlite, 1 Marlite Dr, Dover, OH 4462. Ph: 800-377-1221. www.marlite.com
 - 4) Nudo Products, Inc.
 - 5) Parkland Plastics, Inc.
 - c. Nominal thickness: Not less than 0.09 inch (2.3 mm).
 - d. Surface finish: Smooth (No Texture).

- e. Color: S 100 S/2/S White.
- 2. Basis of Design: Products as manufactured by Marlite.

2.2 ACCESSORIES

- A. Trim Accessories:
 - 1. One-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges:
 - a. Color: Match paneling.
- B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
- C. Concealed Mounting Splines: Continuous, where applicable, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory laminated panels and to be fastened to substrate.
- D. Adhesive: As recommended by FRP manufacturer.
- E. Sealant: Mildew resistant, single component, neutral curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 92 00: Joint Sealants.

PART 3 EXECUTION

3.1 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

3.2 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.3 PREPARATION

- A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels so that trimmed panels at corners are not less than 12 inches (300 mm) wide:
 - 1. Mark plumb lines on substrate at trim accessory panel joint locations for accurate installation.
 - 2. Locate trim accessories panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.4 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned:

1. Drill oversized fastener holes in panels and center fasteners in holes.
 2. Apply sealant to fastener holes before installing fasteners.
- D. Install factory laminated panels using concealed mounting splines in panel joints.
 - E. Install trim accessories with adhesive and nails; no staples. Do not fasten through panels.
 - F. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
 - G. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
 - H. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
 - I. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

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SECTION 07 21 00 - THERMAL INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Extruded polystyrene foam plastic board.
 - 2. Polyisocyanurate foam plastic board.
 - 3. Glass mineral fiber blanket.
 - 4. Rock mineral wool blanket.
 - 5. Rock mineral wool board.
 - 6. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry.
 - 2. Section 07 27 26 - Fluid-Applied Membrane Air Barriers: Vapor retarders.

1.3 REFERENCE STANDARDS

- A. ASTM C167 - Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations; 2018.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- D. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2022.
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- G. ASTM C727 - Standard Practice for Installation and Use of Reflective Insulation in Building Constructions; 2019.
- H. ASTM C764 - Standard Specification for Mineral Fiber Loose-Fill Thermal Insulation; 2019.
- I. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- J. ASTM C1104/C1104M - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation; 2019.
- K. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2021.
- L. ASTM C1321 - Standard Practice for Installation and Use of Interior Radiation Control Coating Systems (IRCCS) in Building Construction; 2015.
- M. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2019.
- N. ASTM C1744 - Standard Practice for Installation and Use of Radiant Barrier Systems (RBS) in Commercial/Industrial Building Construction; 2019.
- O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

- P. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- Q. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C; 2022.
- R. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.
- S. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Technical data and installation instructions for each type of insulation product specified.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Fire Performance Characteristics: Identify products with appropriate markings of applicable testing and inspecting organization
 - a. Surface Burning Characteristics: Per ASTM E84.
 - 1) Flame Spread Index: Maximum 25.
 - 2) Smoke Developed Index: Maximum 450.
 - b. Fire Resistance Ratings: Per ASTM E119.
 - c. Combustion Characteristics: Non-combustible per ASTM E136.
 - 2. Underwriter's Laboratories UL 723 Tests for Surface Burning Characteristics of Building Materials.
- B. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of work.
 - 1. Mark insulation boards and packages with manufacturer's name and product designation. Unmarked boards and packages will be rejected.
- C. Environmental Requirements:
 - 1. Manufacture extruded polystyrene with HCFC or other CFC free blowing agents.
 - 2. Insulations shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.
 - 3. Wherever possible, provide boards from manufacturers who recycle insulation materials.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam plastic board insulation:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.7 PROJECT CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.
- B. Sequence work to ensure fireproofing and firestop materials are in place before beginning work.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. CertainTeed Corporation: www.certainteed.com/building-insulation/.
 - 2. DuPont de Nemours, Inc.: www.dupont.com/#sle.
 - 3. Hunter Panels: www.hunterpanels.com/.
 - 4. Johns Manville; a Berkshire Hathaway company
 - 5. Kingspan Group: www.kingspan.com/us/en/.
 - 6. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 7. Owens Corning: www.owenscorning.com/en-us/insulation/commercial.
 - 8. Rmax, a subsidiary of the Sika Corporation: www.rmax.com/#sle.
 - 9. Rockwool A/S: www.rockwool.com/north-america/
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 EXTRUDED POLYSTYRENE FOAM BOARD

- A. Extruded Polystyrene Foam Board: ASTM C578, Type IV.
 - 1. Subject to compliance with the requirements of this Section, provide one of the following:
 - a. Styrofoam Cavitymate Plus manufactured by DuPont de Nemours, Inc.
 - b. GreenGuard manufactured by Kingspan Group.
 - c. Foamular CW25 manufactured by Owens Corning.

2.3 POLYISOCYANURATE FOAM PLASTIC BOARD

- A. Polyisocyanurate Board, Foil Faced: ASTM C1289, foil faced, Type I, Class 1 or 2.
 - 1. Subject to compliance with the requirements of this Section, provide one of the following:
 - a. Thermax manufactured by DuPont de Nemours, Inc.
 - b. Xci manufactured by Hunter Panels.
 - c. ECOMAXci manufactured by Rmax, Inc.
 - 2. Fire Propagation Characteristics: Pass NFPA 285 testing as part of an approved assembly.

2.4 GLASS MINERAL FIBER INSULATION

- A. Glass Mineral Fiber Batt, Unfaced: ASTM C665, Type I (unfaced); with maximum flame spread and smoke developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.
 - 1. Subject to compliance with the requirements of this Section, provide one of the following:
 - a. CertaPro manufactured by CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. EcoBatt with ECOSE manufactured by Knauf Insulation.
 - d. PINK Next Gen Fiberglas manufactured by Owens Corning.
- B. Glass Mineral Fiber Batt, Kraft Faced: ASTM C665, Type II (nonreflective faced), Class A (faced surface with a flame spread index of 25 or less); Category 1 (membrane is a vapor barrier).
 - 1. Subject to compliance with the requirements of this Section, provide one of the following:

- a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. EcoBatt with ECOSE manufactured by Knauf Insulation.
 - d. PINK Next Gen Fiberglas manufactured by Owens Corning.
- C. Glass Mineral Fiber Board:
1. Subject to compliance with the requirements of this Section, provide one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Earthwool manufactured by Knauf Insulation.
 - d. Fiberglas 700 Series Board manufactured by Owens Corning.
 2. Fire Performance:
 - a. Combustibility: Non-combustible per ASTM E136.
 - b. Surface Burning Characteristics: Per ASTM E84.
 - 1) Flame Spread: 0.
 - 2) Smoke Developed: 0.
 3. Thermal Resistance:
 4. Water Vapor Permeance: 27.2 Perm minimum.
 5. Moisture Absorption: 1% maximum per ASTM C1104/C1104M.
 6. Fungi Resistance: Zero mold growth per ASTM C1338.
 7. Corrosive Resistance:
 - a. Steel per ASTM C665: Pass.
 - b. Stainless Steel per ASTM C795: Pass.

2.5 ROCK MINERAL FIBER INSULATION

- A. Rock Mineral Fiber Blanket: ASTM C665, Type I, complying with ASTM E136 smoke developed and flame spread of 0.
1. Subject to compliance with the requirements of this Section, provide one of the following:
 - a. Thermafiber UltraBatt. manufactured by Owens Corning.
 - b. ComfortBatt manufactured by Rockwool A/S.
 2. Fire Performance:
 - a. Combustibility: Non-combustible per ASTM E136.
 - b. Surface Burning Characteristics: Per ASTM E84.
 - 1) Flame Spread: 0.
 - 2) Smoke developed: 0.
 3. Thermal Resistance: To ASTM C518.
 4. Density: 2 lbs/ft³ to ASTM C167.
- B. Rock Mineral Fiber Board: ASTM C612, Type IVB.
1. Subject to compliance with the requirements of this Section, provide one of the following:
 - a. Thermafiber manufactured by Owens Corning.
 - b. CavityRock manufactured by Rockwool A/S.
 2. Fire Performance:
 - a. Combustibility: Non-combustible per ASTM E136.
 - b. Surface Burning Characteristics: Per ASTM E84.
 - 1) Flame Spread: 0.
 - 2) Smoke Developed: 0.
 3. Thermal Resistance:
 - a. 2" and less R value/1 inch at 75 °F: 4.2 h ft² °F/Btu per ASTM C518.
 - b. 2" and greater R value/1 inch at 75 °F: 4.3 h ft² °F/Btu per ASTM C518.
 4. Water Vapor Permeance: 27.2 Perm minimum
 5. Moisture Absorption: 1% maximum per ASTM C1104/C1104M.
 6. Fungi Resistance: Zero mould growth per ASTM C1338.

7. Corrosive Resistance:
 - a. Steel per ASTM C665: Pass.
 - b. Stainless Steel per ASTM C795: Pass.

2.6 INSULATION FASTENERS

- A. Adhesively Attached, Spindle Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 1. Plate: Perforated, galvanized carbon steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Adhesively Attached, Angle Shaped, Spindle Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 1. Angle: Formed from 0.030 inch (0.762 mm) thick, perforated, galvanized carbon steel sheet with each leg 2 inches (50 mm) square.
 2. Spindle: Copper coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- C. Insulation Retaining Washers: Self-locking washers formed from 0.016 inch (0.41 mm) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
 1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Crawl spaces.
 - b. Ceiling plenums.
 - c. Attic spaces.
- D. Insulation Standoff: Spacer fabricated from galvanized mild steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch (25 mm) between face of insulation and substrate to which anchor is attached.
- E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.7 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 1. Glass Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame spread and smoke developed indexes of 5, per ASTM E84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Board and Batt Insulation: Install insulation that is undamaged, dry, and unsoiled and has not been exposed to ice, rain, or snow at any time.
 1. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Do not seal joints in board insulation. Remove projections that

- interfere with placement.
2. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.
- C. Cavity Wall Insulation: Foam Plastic Board Insulation: Install pads of adhesive spaced approximately 2 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 05 00 - Common Work Results for Masonry.
 2. Cellular Glass Board Insulation: Install with closely fitting joints using attachment method according to manufacturer's written instructions.
- D. Framed Construction, Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. Maintain 3 inch (76 mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 5. For metal framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 6. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - a. Glass Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
 - b. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.
- E. Reflective Insulation: Install sheet reflective insulation according to ASTM C727.
1. Install sheet radiant barriers according to ASTM C1744.
 2. Install interior radiation control coating system according to ASTM C1321.

3.3 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 27 26 - FLUID APPLIED AIR BARRIER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Fluid-applied air barrier membrane in exterior wall assemblies.
- B. Materials to bridge and seal the following air leakage pathways and gaps:
 - 1. Connections of the walls to the roof air barrier.
 - 2. Connections of the walls to the foundation air barrier.
 - 3. Seismic and expansion joints.
 - 4. Openings and penetrations of window frames, storefront, curtain wall and mechanical, electrical and plumbing systems.
 - 5. Barrier precast concrete and other envelope systems.
 - 6. Door frames.
 - 7. Piping, conduit, duct and similar penetrations.
 - 8. Masonry ties, screws, bolts and similar penetrations.
 - 9. All other air leakage pathways in the building envelope.
- C. Related Work in other Sections includes but is not limited to the following:
 - 1. Section 01 45 00 – Quality Control
 - 2. Section 01 50 00 – Temporary Facilities and Controls
 - 3. Section 03 30 00 – Cast-In-Place Concrete
 - 4. Section 04 20 00 – Unit Masonry
 - 5. Section 07 52 19 – Modified Bitumen Membrane Roofing System
 - 6. Section 07 52 19 – Modified Bitumen “Cool Roof” Membrane Roofing System
 - 7. Section 07 54 19 – Fully Adhered Thermoplastic Membrane Roofing System
 - 8. Section 07 54 23 – Fully Adhered Thermoplastic Membrane Roofing System
 - 9. Section 07 65 00 – Flexible Flashing

1.3 PERFORMANCE REQUIREMENTS

- A. Material Performance: Provide air barrier materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.004 cfm / ft² @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).
- B. Provide materials with a water vapor permeance of 10.0 US perms or greater, determined in accordance with ASTM E96 Water method (Procedure B).
- C. Assembly Performance: Provide a continuous air barrier in the form of an assembly that has an air leakage not to exceed 0.04 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.04 cfm/ft² @ 1.57 psf) when tested in accordance with ASTM E2357. The assembly shall accommodate movements of building materials by providing expansion and control joints as required. Expansion / control joints, changes in substrate and perimeter conditions shall have appropriate accessory materials at such locations.

1. The air barrier assembly shall be capable of withstanding combined design wind, fan and stack pressures, both positive and negative on the envelope without damage or displacement, and shall transfer the load to the structure.
 2. Fluid applied air barriers shall not displace adjacent materials in the air barrier assembly under full load.
 3. The air barrier assembly shall be joined in an airtight and flexible manner to the air barrier materials of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations, creep, and anticipated seismic movement.
- D. Connections to Adjacent Materials: Provide connections to prevent air leakage at the following locations:
1. Foundation and walls, including penetrations, ties and anchors.
 2. Walls, windows, curtain walls, storefronts, louvers or doors.
 3. Different wall assemblies, and fixed openings within those assemblies.
 4. Wall and roof connections.
 5. Floors over unconditioned space.
 6. Walls, floor and roof across construction, control and expansion joints.
 7. Walls, floors and roof to utility, pipe and duct penetrations.
 8. Seismic and expansion joints.
 9. All other potential air leakage pathways in the building envelope.

1.4 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination

1.5 SUBMITTALS

- A. Submittals: Submit in accordance with Division 1 requirements.
- B. Installer Qualifications: Submit evidence of current Contractor accreditation and Installer certification under the Air Barrier Association of America's (ABAA). Submit accreditation number of the Contractor and certification number(s) of the ABAA Certified Installer(s).
- C. Product Data: Submit material Manufacturer's Product Data, material Manufacturer's instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, Technical Data, and tested physical and performance properties.
1. Submit letter from primary air barrier material Manufacturer indicating approval of materials that are proposed to be used that are not currently listed in the accessories section of this specification for that Manufacturer's material.
 2. Include statement from the primary air barrier material Manufacturer that the materials used in their air barrier assembly which will be used to adhere to the underlying substrate are chemically compatible to the substrate material.
- D. Samples: Submit clearly labeled samples, three (3) inch by four (4) inch minimum size of each material specified.
- E. Field Test Results of Mock-Up: Submit test results of air leakage test and water leakage test of mock-up in accordance with specified standards, including retesting if initial results are not satisfactory.

- F. Compatibility: Submit letter from primary material Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use.

1.6 QUALITY ASSURANCE

- A. Air Barrier Installer Qualifications: Air barrier Subcontractor(s) shall be accredited at the time of bidding and during the complete installation period by the Air Barrier Association of America (ABAA).
 - 1. Fluid-applied membrane air barrier Installer(s) shall be certified in accordance with the requirements outlined by ABAA. Installers shall have their photo identification air barrier certification cards in their possession and available on the project site, for inspection upon request.
- B. Manufacturer: Obtain primary ABAA Evaluated Materials from a single ABAA Evaluated Manufacturer regularly engaged in manufacturing specified fluid-applied membranes. Obtain secondary materials from a source acceptable to the primary materials Manufacturer.
- C. Accredited Laboratory Testing for Materials: Laboratory accredited by International Accreditation Service Inc. (IAS), American Association for Laboratory Accreditation (A2LA), or the Standards Council of Canada (SCC).
- D. VOC Regulations: Provide products which comply with applicable regulations controlling the use of volatile organic compounds.
- E. Preconstruction Meeting: Convene a minimum of two weeks prior to commencing Work of this Section. Agenda shall include, at a minimum, construction of mock-up, sequence of construction, coordination with substrate preparation, air barrier materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction and chemical/fire safety plans. Attendance is required by the Fluid Applied Air Barrier System Manufacturer's field representative, representatives of related trades including covering materials, substrate materials and adjacent materials.
- F. Mock-Ups: Build mock-up representative of primary air barrier assemblies and glazing assemblies including backup wall and typical penetrations as acceptable to the Architect. Mock-up shall be dimensioned no less than eight (8) feet long by eight (8) feet high and include the air barrier materials and air barrier accessories proposed for use in the exterior wall assembly. The mock-ups shall remain visible and intact for the duration of the fluid applied air barrier system work scopes.
- G. Mock-Up Tests for Air and Water Infiltration: The General Contractor shall provide testing of the window and door opening(s) in the mock-up for air and water infiltration. The testing shall be in accordance with AAMA 501.2 (hand wand field testing), If deficiencies are found, the air barrier Contractor shall reconstruct mock-up at their cost for retesting until satisfactory results are obtained. Deficiencies include air leakage beyond values specified, uncontrolled water leakage, unsatisfactory workmanship.
- H. Air Barrier Assembly Testing: Verify air barrier assembly testing by the material Manufacturer by visiting the ABAA website to ensure an ASTM E2357 test has been completed and to obtain results. Visit the ABAA website for the reported air barrier assembly leakage rate and illustrations or CAD details which includes the methods in which the assembly test mock-ups shall be assembled.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original packages with seals unbroken, labeled with material Manufacturer's name, product, date of manufacture, and directions for storage.
- B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by material Manufacturer. Protect stored materials from direct sunlight and other sources of ultra-violet light.
- C. Handle materials in accordance with Manufacturer's recommendations.

1.8 PROJECT CONDITIONS

- A. Temperature: Install fluid-applied air barrier material within range of ambient and substrate temperatures recommended by material Manufacturer. Do not apply air barrier to a damp or wet substrate.
- B. Field Conditions: Do not install air barrier in snow, rain, fog, or mist. Do not install air barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the Manufacturer.
- C. Sequencing: Do not install air barrier material before the roof assembly has been sufficiently installed to prevent a buildup of water in the interior of the building.
- D. Compatibility: Do not allow air barrier materials to come in contact with chemically incompatible materials.
- E. Ultra-violet exposure: Do not expose air barrier materials to sunlight longer than as recommended by the material Manufacturer.

1.9 WARRANTY

- A. Material Warranty: Provide Manufacturer's standard product warranty, for a minimum 20 years from date of Substantial Completion.
- B. Subcontractor (approved by ABAA and Manufacturer) Installation Warranty: Provide a five (5) year installation warranty from date of Substantial Completion, including all accessories and materials of the air barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of attachment, loss of adhesion and failure to cure properly.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fluid Applied Membrane Air Barrier: Use regular, high temperature or low-temperature formulation depending on site conditions, within temperature ranges specified by Manufacturer. Subject to compliance with requirements, provide one of the following:
 - 1. BASF Corporation: MasterSeal AWB 660, Enershield HP, Finestop RA, Senershield R, Acrostop R and Sonowall FT R. Thickness for products are as specified by Manufacturer.
www.wallsystems.basf.com:
 - a. AIR BARRIER MATERIAL PROPERTIES:

- 1) Air permeance for this material has been tested and reported as being 0.0000 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0000 cfm/ft² @ 1.57 psf), at 10 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 1004 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1004 ng/(Pa·s·m²) / 17.6 US perms) at 10 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Fabric Reinforcement: Sheathing fabric to be saturated with BASF Fluid-Applied Membrane for use at sheathing joints, penetrations and window rough openings.
 - 2) Flashing and Transition Membrane: WS Wrap polyester-faced 30-mil self-adhesive membrane or WS Membrane 20-mil self-adhesive membrane.
 - 3) Water-based Primer for Self-Adhesive Membranes: WS Flashing Primer.
 - 4) Mastics: As recommended by Manufacturer.
2. Carlisle Coatings and Waterproofing: Fire-Resist Barritech VP at 60 mils thick (wet). www.carlisle-ccw.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.0002 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0002 cfm/ft² @ 1.57 psf), at 65 mils (wet), when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 817 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (817 ng/(Pa·s·m²) / 14.295 US perms) at 60 mils (wet) [40 mils (dry)] when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Detail Flashing: Fire-Resist 705 FR.
 - 2) Counter-flashing for Metal Wall Flashings: Fire-Resist 705 FR.
 - 3) Water-Based Primer for Detail Flashing: CCW-702 WB.
 - 4) Solvent-Based Primer for Detail Flashing: CCW-702 or CCW-702 LV.
 - 5) Solvent-Based Aerosol Primer for Detail Flashing: CAV-GRIP.
 - 6) Reinforcing Fabric: DCH Reinforcing Fabric.
 - 7) Glass Mat: LiquiFiber-W.
 - 8) Termination Mastic: SURE-SEAL Lap Sealant.
 - 9) Fill Compound: CCW-201 or CCW-703 V.
3. Dow Corning: DefendAir 200 at 15 mils thick (dry). www.buildabetterbarrier.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.0010 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0010 cfm/ft² @ 1.57 psf), [0.0049 liters per square meter per second under a pressure differential of 75 Pa (0.0049 L/(s·m²) @ 75 Pa)] at 15 mils (dry), when tested in accordance with ASTM E2178 (unmodified).

- 2) Water vapor permeance for this material has been tested and reported as being 1387.7 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1387.7 ng/(Pa·s·m²) [24.26 US perms] at 15 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Solvent-Based Primer: Dow Corning® DefendAir Primer
 - 2) Sealants: Dow Corning® 791 Silicone Weatherseal Sealant, Dow Corning® 756 SMS Silicone Sealant, Dow Corning® 795 Silicone Building Sealant, Dow Corning® 758 Silicone Weather Barrier Sealant
 - 3) Transition Membrane for details and terminations: Dow Corning® 778, Dow Corning® Silicone Transition Strip
 - 4) Flashing at Transition Membrane: Dow Corning® Silicone Transition Strip
 - 5) Counterflashing for Through-Wall Flashings: Dow Corning® Silicone Transition Strip
 - 6) Through-Wall Flashings or Shelf Angle Flashings: Dow Corning® 778 below the flexible through wall flashing system.
 - 7) Substrate Joint Treatment: Dow Corning® 791 Silicone Weatherseal Sealant
4. Dryvit Systems, Inc: Backstop NT at 12mils thick (dry). www.dryvit.com:
 - a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.000118 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000118 cfm/ft² @ 1.57 psf), [0.0006 liters per square meter per second under a pressure differential of 75 Pa (0.0006 L/(s·m²) @ 75 Pa)] at 12 mils (dry), when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 1810 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1810 ng/(Pa·s·m²) [31.65 US perms] at 20 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Transition Membrane for details and terminations: Dryvit AquaFlash and AquaFlash Mesh
 - 2) Reinforcing / Joint Tape: Dryvit Grid Tape
 - 3) Flashing at Transition Membrane: Dryvit AquaFlash
 - 4) Substrate Joint Treatment: Dryvit Grid Tape with Backstop NT
5. DuPont Building Innovations: Tyvek Fluid Applied WB at 25 mils thick (wet), 25 mils thick (dry). www.Weatherization.Tyvek.com:
 - a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.0002 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0002 cfm/ft² @ 1.57 psf), at 25 mils (dry), when tested in accordance with ASTM E2178 (unmodified).

- 2) Water vapor permeance for this material has been tested and reported as being 1384 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential ($1384 \text{ ng}/(\text{Pa}\cdot\text{s}\cdot\text{m}^2)$ / 24.23 US perms) at 25 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Solvent Based Primer for Flashing, Transition Strip and Detail Membranes: 3M High Strength 90; Denso Butyl (used with self-adhered membranes only).
 - 2) Through-Wall Flashings or Shelf Angle Flashings: DuPont recommended through-wall flashing.
 - 3) Sealants, Mastics, Adhesives and Tapes: DuPont Sealant for Tyvek Fluid Applied System; DuPont Tyvek Flashing and Joint Compound; fiberglass mesh tape.
 - 4) Transition, Termination, and Detailing Membrane: DuPont StraightFlash, or DuPont Tyvek Flashing and Joint Compound (60mil).
 - 5) Penetrations and Termination Sealant: DuPont Sealant for Tyvek Fluid Applied System.
 - 6) Window Flashing Membrane: DuPont Tyvek Fluid Applied Flashing and Joint Compound, or DuPont Tyvek Fluid Applied Flashing – Brush Formulation, or DuPont StraightFlash with DuPont FlexWrap.
 - 7) Joint Treatment: None ($\leq 1/16"$ gaps); DuPont Tyvek Flashing and Joint Compound ($\leq 1/4"$ gaps); DuPont Tyvek Flashing and Joint Compound w/ fiberglass mesh tape ($\leq 1/2"$ gaps); DuPont StraightFlash ($\leq 1"$ gaps).
6. Grace Construction Products: Perm-A-Barrier VP, 90 mils thick (wet), 45 mils thick (dry).
www.na.graceconstruction.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.0004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot ($0.0004 \text{ cfm}/\text{ft}^2 @ 1.57 \text{ psf}$), at 69 mils (wet), when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 741.6 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential ($741.6 \text{ ng}/(\text{Pa}\cdot\text{s}\cdot\text{m}^2)$ / 12.9 US perms) at 40 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Membrane for details and Terminations: Bituthene Liquid Membrane.
 - 2) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Perm-A-Barrier WB Primer or Perm-A-Barrier Primer Plus.
 - 3) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Bituthene Primer B-2 and Bituthene Primer B2 LVC or Bituthene Primer B2.
 - 4) Through-Wall Flashings or Shelf Angle Flashings: Perm-A-Barrier Wall Flashing below the flexible through wall flashing system.
 - 5) Sealants, Mastics, Adhesives and Tapes: As recommended by Grace Construction Products.
 - 6) Transition Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.

- 7) Penetrations and Termination Sealant: Bituthene Liquid Membrane and as recommended by Grace Construction Products.
 - 8) Window Flashing and Detail Membrane: Perm-A-Barrier Detail Membrane, Perm-A-Barrier Aluminum Flashing and Perm-A-Barrier Wall Flashing.
 - 9) Joint Sealant: Refer to Technical Letter 1 for details on compatible waterproofing sealants.
7. Henry Company: Air Bloc 17MR at 48 mils (wet) - *Medium build option*. www.henry.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.00024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0001 cfm/ft² @ 1.57 psf), at 48 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 28 US perms at 25 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Liquid Applied Flashing: Air-Bloc LF.
 - 2) Transition Membrane: Blueskin SA and Blueskin SALT for low-temperature applications.
 - 3) Sheathing Joint Membrane: Blueskin VP160.
 - 4) Spray Adhesive: Blueskin Adhesive and Blueskin LVC Adhesive.
 - 5) Water-Based Primer for Transition Membrane: Aquatac Primer.
 - 6) Counterflashing for Metal Panel Through-Wall Flashing: Blueskin TWF.
 - 7) Sealant: HE 925 BES Sealant.
 - 8) Reinforcing Tape: HE 183 Yellow Glass Fabric.
 - 9) Insulation Adhesive: Air-Bloc 21.
8. Momentive Performance Materials, Inc.: GE Elemax 2600 at 17 mils (dry). www.ge.com/silicones:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.0006 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0006 cfm/ft² @ 1.57 psf), at 17 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 581 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (581 ng/(Pa·s·m²) / 10.16 US perms) at 17 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Solvent-Based Primer: SS80.
 - 2) Sealants: Elemax 5000 Liquid Flashing; SilPruf SCS2000; SilPruf SCS9000; SilPruf SCS2700; SWS.
 - 3) Transition Membrane for details and terminations: Elemax 5000 Liquid Flashing; UltraSpan UST2200; UltraSpan USM pre-formed silicone molded corners parts.

- 4) Substrate Joint Treatment: Elemax 5000 Liquid Flashing; SilPruf SCS2000; SilPruf SCS9000; SilPruf SCS2700; SWS.
 - 5) Reinforcing Fabric: RF100.
9. Pecora USA: Pecora XL-Perm ULTRA VP by Pecora USA at 9 – 12 mils (dry). www.pecora.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.00024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00024 cfm/ft² @ 1.57 psf), 0.0012 liters per square meter per second under a pressure differential of 75 Pa (0.0012 L/(s·m²) @ 75 Pa)] at 12 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 727.01 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (727.01 ng/(Pa·s·m²) (12.71 US perms) at 9 mils - dry when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Sealants: 890NST Silicone Sealant, AVB Silicone Sealant
 - 2) Transition Membrane for details and terminations: XL Span
 - 3) Flashing at Transition Membranes: XL Flash Liquid Flashing & Joint Filler
 - 4) Counter-Flashing for Through-Wall Flashings: XL Flash Liquid Flashing & Joint Filler with Flexible Flashing.
 - 5) Through-Wall Flashings or Shelf Angle Flashings: XL Flash Liquid Flashing & Joint Filler below the flexible through wall flashing system.
 - 6) Substrate Joint Treatment: XL Flash Liquid Flashing & Joint Filler, 890 NST Silicone Sealant, AC-20 Latex Sealant, AVW-920 Latex Sealant, Dynatrol I-XL-345 Tru White STPU Sealant
10. PROSOCO, Inc.: Spray Wrap MVP at 10 mils (wet). www.prosoco.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.00086 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00086 cfm/ft² @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 1430 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1430 ng/(Pa·s·m²) / 25 US perms) at 10 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Water-Based Primer: PROSOCO R-GUARD PorePrep for cut gyp board edged in rough openings.
 - 2) Sealants: PROSOCO R-GUARD AirDam for interior perimeter seal in window installations.
 - 3) Transition Membrane for details and terminations: PROSOCO R-GUARD SureSpan EX

- 4) Flashing at Transition Membrane: PROSOCO R-GUARD FastFlash
 - 5) Counter-flashing for Through-Wall Flashings: Combination of PROSOCO R-GUARD Joint & Seam Filler and PROSOCO R-GUARD FastFlash or FastFlash alone as a fill and flashing product.
 - 6) Through-Wall Flashings or Shelf Angle Flashings: Combination of PROSOCO R-GUARD Joint & Seam Filler and PROSOCO R-GUARD FastFlash or FastFlash alone as a fill product and flashing below the flexible through wall flashing system.
 - 7) Substrate Joint Treatment: PROSOCO R-GUARD FastFlash and / or PROSOCO R-GUARD Joint & Seam Filler.
 - 8) Rough Openings: PROSOCO R-GUARD Joint and Seam Filler followed by PROSOCO R-GUARD FastFlash.
11. PROSOCO, Inc.: Cat 5 at 12 - 15 mils (wet). www.prosoco.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.00018 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00018 cfm/ft² @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 1015 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1015 ng/(Pa·s·m²) / 17.71 US perms) at 12 – 15 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Water-Based Primer: PROSOCO R-GUARD GypPrime for cut gyp board edged in rough openings.
 - 2) Sealants: PROSOCO R-GUARD AirDam for interior perimeter seal in window installations.
 - 3) Counter-flashing for Through-Wall Flashings: PROSOCO R-GUARD Joint and Seam Filler followed by PROSOCO R-GUARD FastFlash.
 - 4) Through-Wall Flashings or Shelf Angle Flashings: PROSOCO R-GUARD Joint and Seam Filler followed by PROSOCO R-GUARD FastFlash below the flexible through wall flashing system.
 - 5) Substrate Joint Treatment: PROSOCO R-GUARD Joint & Seam Filler for sheathing seams, PROSOCO R-GUARD Joint & Seam Filler covered by PROSOCO R-GUARD FastFlash in rough opening.
12. Protecto Wrap: Protecto Wall Liquid Air Barrier VP by at 10 mils (dry). www.protectowrap.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.00086 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000864 cfm/ft² @ 1.57 psf), 0.0043 liters per square meter per second under a pressure differential of 75 Pa (0.0043 L/(s·m²) @ 75 Pa)] at 10 mils (dry) when tested in accordance with ASTM E2178 (unmodified).

- 2) Water vapor permeance for this material has been tested and reported as being 660.8 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (660.8 ng/(Pa·s·m²) [11.5 US perms] at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Water-Based Primer: Universal Water Based Primer.
 - 2) Solvent-Based Primer: BT Primer.
 - 3) Solvent-Based Aerosol Primer: Protecto-Tak Spray Adhesive.
 - 4) Sealants: Protecto Wall Board to Board Joint Sealant.
 - 5) Transition Membrane for details and terminations: Protecto Wall Transition Tape.
 - 6) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: BT Primer.
 - 7) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Universal Water Based Primer.
 - 8) Substrate Joint Treatment: Protecto Wall Board to Board Joint Sealant.
13. Sika Corporation: Sikagard 530 Liquid Applied Vapor Permeable Air Barrier at 30 mils (dry). www.sika.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being < 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (< 0.0001 cfm/ft² @ 1.57 psf), at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 661 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (661 ng/(Pa·s·m²) / 11.5 US perms) at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Water-Based Primer: Sikagard 530.
 - 2) Solvent-Based Primer: Sikagard 510.
 - 3) Termination Mastic: Sikaflex 11FC.
 - 4) Sealants: Sikaflex 11FC.
 - 5) Transition Membrane for details and terminations: SikaMultiSeal 515.
 - 6) Reinforcing/Joint Tape: SikaMultiSeal 515.
 - 7) Counterflashing for Through-Wall Flashings: SikaMultiSeal Plus with Flexible Flashing.
 - 8) Through-Wall Flashings or Shelf Angle Flashings: SikaMultiSeal Plus below the flexible through wall flashing system.
 - 9) Substrate Joint Treatment: Sikaflex 11FC.
14. Soproma: Sopraseal LM 202 VP at 10 mils (wet) www.soprema.us
- a. AIR BARRIER MATERIAL PROPERTIES:

- 1) Air permeance for this material has been tested and reported as being 0.00004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00004 cfm/ft² @ 1.57 psf), [0.0002 liters per square meter per second under a pressure differential of 75 Pa (0.0002 L/(s·m²) @ 75 Pa)] at 10 mils (wet) when tested in accordance with ASTM E 2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 1004 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1004 ng/(Pa·s·m²) [17.6 US perms] at 10 mils (wet) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Water Based Primer: Soprema Elastocol Stick H20 Primer
 - 2) Solvent-Based Primer: Soprema Sopraseal Stick primer
 - 3) Sealants: Soprema Sopraseal sealant
 - 4) Transition Membrane for details and terminations: Soprema Sopraseal Stick 1100T or Soprema Soprsolin HD
 - 5) Substrate Joint Treatment: Soprema Sopraseal Mesh
15. Sto Corp: Emerald Coat at 20 mils (dry). www.stocorp.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.000024 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.00024 cfm/ft² @ 1.57 psf), [0.00020 liters per square meter per second under a pressure differential of 75 Pa (0.00020 L/(s·m²) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 797.94 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (797.94 ng/(Pa·s·m²) [13.95 US perms] at 12 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Joint and Rough Opening Treatments: Sto Gold Fill with StoGuard Mesh, StoGuard Rapid Seal with StoGuard Mesh, Sto EmeraldCoat with SToGuard Fabric, StoGuard Tape
 - 2) Joint Reinforcements: StoGuard Mesh, StoGuard Fabric, StoGuard RediCorner
 - 3) Transition Membranes: Sto Gold Fill with StoGuard Mesh, StoGuard RapidSeal or StoGuard RapidSeal with StoGuard Mesh, Sto Emerald Cost with StoGuard Fabric, StoGuard Tape
 - 4) Water-Based Primer for use with Flashing Transition: StoGuard
16. STS Coatings: Wall Guardian FW-100-A (Acrylic-based component) 40 mils (wet), 20 mils (dry). www.wallguardian.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.0001 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0001 cfm/ft² @ 1.57 psf), at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).

- 2) Water vapor permeance for this material has been tested and reported as being 661 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential ($661 \text{ ng}/(\text{Pa}\cdot\text{s}\cdot\text{m}^2)$ / 11.5 US perms) at 22 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: None.
 - 2) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: BP-40 Primer for use with UT-40 Universal Tape.
 - 3) Through-Wall Flashings or Shelf Angle Flashings: Gorilla Flash VF-1000.
 - 4) Mastics: None.
 - 5) Adhesives and Tapes: Universal Tape UT-40, a butyl based tape and Great Seal LT-100, a low voc elastomeric sealant for deflection joints and details.
 - 6) Transition Strip: Universal Tape, UT-40.
 - 7) Termination Mastic: Great Seal LT-100.
 - 8) Window Flashing and Detail Membrane: Universal Tape UT-40.
17. TK Products: TK-AirMax 2103 at 40+ mils (wet). www.tkproducts.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
- 1) Air permeance for this material has been tested and reported as being 0.00097 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot ($0.00097 \text{ cfm}/\text{ft}^2 @ 1.57 \text{ psf}$), 0.00492 liters per square meter per second under a pressure differential of 75 Pa ($0.00492 \text{ L}/(\text{s}\cdot\text{m}^2) @ 75 \text{ Pa}$] at 40 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 857 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential ($857 \text{ ng}/(\text{Pa}\cdot\text{s}\cdot\text{m}^2)$ [15.0 US perms] at 20 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).
- b. AIR BARRIER ACCESSORY MATERIALS:
- 1) Through-Wall Flashings or Shelf Angle Flashings: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18 below the flexible through wall flashing system.
 - 2) Caulk: TK-Super Seal
 - 3) Adhesives and Tapes: TK-AirMax 2200 All Weather Flashing (TK Products), TK Air Max 2203 Caulk, TK-AirMax 2201 Red Sheathing Facing Tape (Venture Tape, a 3M Company), 3M All-Weather Flashing Tape 8067 (3M Company), VentureStop VB 400 (Venture Tape, a 3M Company), Venture-1585 CW-2 Red Sheathing Facing Tape (Venture Tape, a 3M Company)
 - 4) Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
 - 5) Reinforcing / Joint Tape: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
 - 6) Termination of Caulk: TK-AirMax Caulk 2203 (TK Products), Manus-Bond 75AM (Manus Products, Inc.)
 - 7) Flashing (Counter) for at Through-Wall Flashings or Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18
18. TK Products: TK-AirMax 2104 at 40+ mils (wet). www.tkproducts.com:

a. AIR BARRIER MATERIAL PROPERTIES:

- 1) Air permeance for this material has been tested and reported as being 0.0008 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0008 cfm/ft² @ 1.57 psf), at 40+ mils (wet) when tested in accordance with ASTM E2178 (unmodified).
- 2) Water vapor permeance for this material has been tested and reported as being 1007 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1007 ng/(Pa·s·m²) / 17.6 US perms) at 14 mils (dry) when tested in accordance with ASTM E96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

- 1) Through-Wall Flashings or Shelf Angle Flashings: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18 below the flexible through wall flashing system.
- 2) Caulk: TK-Super Seal.
- 3) Adhesives and Tapes: TK-AirMax 2200 All Weather Flashing (TK Products), TK Air Max 2203 Caulk, TK-AirMax 2201 Red Sheathing Facing Tape (Venture Tape, a 3M Company), 3M All-Weather Flashing Tape 8067 (3M Company), VentureStop VB 400 (Venture Tape, a 3M Company), Venture-1585 CW-2 Red Sheathing Facing Tape (Venture Tape, a 3M Company).
- 4) Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18.
- 5) Reinforcing / Joint Tape: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18.
- 6) Termination of Caulk: TK-AirMax Caulk 2203 (TK Products), Manus-Bond 75AM (Manus Products, Inc.)
- 7) Flashing (Counter) for at Through-Wall Flashings or Transition Membranes: TK-Climate Flash, TK-Butyl Bond, TK-SS Flashing, TK-TWF-18.

19. Tremco, Inc.: ExoAir 230 at 40 mils (wet) www.tremcosealants.com

a. AIR BARRIER MATERIAL PROPERTIES:

- 1) Air permeance for this material has been tested and reported as being 0.0003 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.0003 cfm/ft² @ 1.57 psf), at 40 mils (wet) when tested in accordance with ASTM E2178 (unmodified).
- 2) Water vapor permeance for this material has been tested and reported as being 1677 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (1677 ng/(Pa·s·m²) at 29 mils (dry) when tested in accordance with ASTM E 96 (water method – unmodified).

b. AIR BARRIER ACCESSORY MATERIALS:

- 1) Solvent Based Primer: ExoAir Primer
- 2) Termination Mastic: ExoAir Termination Mastic
- 3) Sealants: Tremflex 834, Dymonic 100, Spectrem 1
- 4) Transition Membrane for Details and Terminations: ExoAir 110, ExoAir 111, ExoAir TWF, Dymonic 100
- 5) Reinforcing / Joint Tape: Tremco 2011 mesh

- 6) Flashing at Transition Membrane: ExoAir 111, ExoAir TWF, Dymonic 100
 - 7) Counterflashing for Through Wall Flashings: ExoAir TWF
 - 8) Through Wall Flashings or Shelf Angle Flashings: ExoAir TWF below the flexible through wall flashing system.
 - 9) Solvent Based Primer for Flashing, Transition Strip and Detail Membrane: ExoAir Primer
 - 10) Substrate Joint Treatment: Tremflex 834, Dymonic 100 depending on substrate.
20. W.R. Meadows, Inc.: Air-Shield LMP, at 60 mils (wet), 30 mils (dry).
www.wrmeadows.com:
- a. AIR BARRIER MATERIAL PROPERTIES:
 - 1) Air permeance for this material has been tested and reported as being 0.000096 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.000096 cfm/ft² @ 1.57 psf), [0.00048 liters per square meter per second under a pressure differential of 75 Pa (0.00048 L/(s·m²) @ 75 Pa)] at 20 mils (dry) when tested in accordance with ASTM E2178 (unmodified).
 - 2) Water vapor permeance for this material has been tested and reported as being 598 nanograms of water vapor passing through each square meter of area per second for each Pascal of vapor pressure differential (598 ng/(Pa·s·m²) [10.47 US perms] at 30 mils (dry) when tested in accordance with ASTM E 96 (water method – unmodified).
 - b. AIR BARRIER ACCESSORY MATERIALS:
 - 1) Water-Based Primer: None required for Air Shield LMP.
 - 2) Solvent-Based Primer: None required for Air Shield LMP.
 - 3) Solvent-Based Aerosol Primer: None required for Air Shield LMP.
 - 4) Termination Mastic: Pointing Mastic or BEM.
 - 5) Transition Membrane for details and terminations: Air Shield.
 - 6) Reinforcing / Joint Tape: Reinforcing Fabric HCR.
 - 7) Flashing at Transition Membrane: Air Shield Thru-Wall Flashing.
 - 8) Counter-flashing for Through-Wall Flashings: Air Shield Thru-Wall Flashing.
 - 9) Through-Wall Flashings or Shelf Angle Flashings: Air Shield Thru-Wall Flashing below the flexible through wall flashing system.
 - 10) Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime VOC.
 - 11) Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Mel-Prime WB.
 - 12) Substrate Joint Treatment: Air Shield Joint Filler.

2.2 AUXILIARY MATERIALS

- A. Transition Membrane Between Air and Vapor Barrier Membrane and Roofing and Other Adjacent Materials: Comply with both air barrier Manufacturer's recommendations and roofing material Manufacturer's recommendations.
- B. Provide primers, glass fabric scrim tape, mastic, and other materials not specifically described, but required for a complete and proper installation as instructed by the air barrier system Manufacturer or required to provide a continuous the air barrier assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The ABAA Certified Air Barrier Contractor shall examine substrates, areas, and conditions under which the air barrier assembly will be installed, with ABAA Certified Installer present, for compliance with requirements.
1. Confirm site access logistics and scheduling requirements, including but not limited to use of scaffolding, lifts and staging.
 2. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
 3. Ensure that the following conditions are met:
 - a. Surfaces are sound, dry, even, and excess mortar and / or other contaminants.
 - b. Inspect and confirm substrates to be smooth and without large voids or sharp protrusions. Inform General Contractor if substrates are not acceptable and need to be repaired by the substrate Subcontractor.
 - c. Inspect and confirm masonry joints to be reasonably flush and completely filled, and ensure all excess mortar accumulated on masonry ties has been removed. Inform General Contractor if masonry joints are not acceptable and need to be repaired by the masonry Subcontractor.
 - d. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
 4. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 and take suitable measures until substrate passes moisture test.
 5. Verify sealants are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.
 6. Notify Architect in writing of anticipated problems using air and vapor barrier over substrate prior to proceeding.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrate according to material Manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
1. Ensure that penetrating work by other trades is in place and complete.
 2. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the fluid-applied membrane.
 3. Wipe down metal surfaces to remove release agents or other non-compatible coatings using clean sponges or with a material chemically compatible with the primary air material.
- B. Prime substrate for installation of sheet membrane transition strips as recommended by material Manufacturer and as follows:
1. Prime masonry, concrete substrates with conditioning primers.
 2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
 3. Prime wood, metal, and painted substrates with primer.
 4. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier at protrusions.
- C. Prime substrate for installation of fluid-applied air barrier if recommended by material Manufacturer based on project conditions.
- D. Protection from spray-applied materials as recommended by material Manufacturer and as follows:

1. Mask and cover adjacent areas to protect from over-spray.
2. Ensure any required foam stop or back up materials are in place to prevent over-spray and achieve complete seal.

3.3 INSTALLATION

- A. Fluid Applied Membrane Air Barrier: Install air barrier accessories and fluid-applied membrane air barrier material to provide continuity throughout the building envelope in a shingle fashion. Install materials in accordance with material Manufacturer's instructions and the following (unless Manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials):
1. Install veneer anchors as per air barrier Manufacturer installation sequencing.
 2. Apply treatment to exterior gypsum joints and screw heads as per air barrier material Manufacturer.
 3. Apply primer for transition material at the rate instructed by the air barrier material Manufacturer for 1 inch beyond terminating edge of transition membrane. Allow primer to set / cure completely before transition strip application.
 4. Position subsequent sheets of transition material so that membrane overlaps the membrane sheet below by a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer. Ensure transition membrane is securely sealed onto substrate with roller.
 5. Overlap horizontally adjacent pieces of transition material a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer. Roll all areas of transition strip including seams with roller.
 6. Seal around all penetrations with termination mastic / sealant, membrane counterflashing or other procedure in accordance with material Manufacturer's instructions, ensuring chemical compatibility amongst adjoining materials.
 7. Connect air barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors, other intersection conditions and transitions from wet cavity to dry cavity and seal penetrations using accessory materials in accordance with the material Manufacturer's instructions.
 8. Provide transition material at changes in substrate plane (with bead of sealant / mastic, membrane counter-flashing or other material recommended by material Manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
 9. Provide mechanically fastened non-corrosive metal sheet or other Manufacturer approved transition material to span gaps greater than 1 inch in substrate plane and to make a smooth transition from one plane to the other. Transition membrane shall be installed continuously from air barrier material onto sheet metal maintaining 2 inch overlap on both edges.
 10. Lap transition material over top edge of through-wall flashing and head-flashing.
 11. Provide backup for the membrane to accommodate anticipated movement or use other Manufacturer approved transition material at deflection and control joints.
 12. Provide transition material to joint assemblies at expansion and seismic joints.
 13. Provide backup for the fluid applied air barrier to accommodate anticipated movement at deflection and control joints as recommended by material Manufacturer.
 14. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and / or as otherwise recommended by the material Manufacturer.
 15. Seal top edge of the self-adhered membrane to substrate with termination mastic at end of each working day.

16. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by material Manufacturer.
17. Install primer for fluid-applied air barrier if instructed by material Manufacturer.
18. Install fluid-applied membrane using equipment and methods recommended by Manufacturer to achieve a dry film thickness as required by the material Manufacturer.
19. Do not allow materials to come in contact with chemically incompatible materials.
20. Do not expose membrane to sunlight / ultraviolet light longer than as recommended by the Manufacturer.
21. Turn flashing membrane into window opening at sill, jambs and heads. Terminate just before interior sealant bead.

3.4 FIELD QUALITY CONTROL

- A. Owner's Inspection and Testing: Cooperate with Owner's testing agency as applicable. Allow access to work areas and staging. Notify Owner's testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.
- B. Manufacturer's Field Representative Review: Contractor is not to commence any work other than staging until contact and meeting with the Manufacturer's Field Representative on site. The Manufacturer's Field Representative is to visit the jobsite a minimum of four (4) times to review work processes and / or work completed prior to work commencement, at 10% completion, at 50% completion and prior to the work being covered by finish materials.

3.5 PROTECTING AND CLEANING

- A. Protect air barrier materials from damage during installation and the remainder of the construction period, according to material Manufacturer's written instructions.
 1. Coordinate with installation of materials which cover the air barrier assemblies, to ensure exposure period does not exceed that recommended by the air barrier Manufacturer.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by Manufacturer of affected construction and acceptable to the primary material Manufacturer.

END OF SECTION 07 27 26

SECTION 07 52 19 - MODIFIED BITUMEN “COOL ROOF” MEMBRANE ROOFING SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Providing coordination for the entire roofing assembly, including, but not limited to:
1. Tapered edge strips, cant strips, and wood nailers. (Refer to this Section and Section 06 10 00)
 2. Modified bitumen membrane roofing
 3. Flashings, including sheet metal perimeter edge (fascia) (Refer this Section and Section 07 62 00).
 4. Work incidental to, the complete and proper installation of a watertight modified bitumen membrane roofing system as shown on the drawings or specified herein, and in accordance with all applicable requirements of the Contract Documents.
- B. It is the intent of this Section that the Work shall:
1. provide a watertight facility;
 2. conform to all applicable building code requirements and of authorities having jurisdiction;
 3. include Section 07 62 00, Roof Related Sheet Metal as part of the Work of this Section; and be performed to obtain a single responsibility total system warranty.
- C. Work and materials hereinafter specified shall be best of kind described and, unless specified otherwise, shall be new and of best quality. All roofing materials utilized in performance of each type of work shall be the products of one (1) manufacturer or supplier.

1.3 RELATED WORK

- A. All Sections of Work relating to the roofing system, including mechanical, plumbing and electrical items penetrating the roof system.

1.4 1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM)
1. C920, Standard Specification for Elastomeric Joint Sealants
 2. D41, Standard Specification for Asphalt Primer Used in Roofing, Damproofing, and Waterproofing
 3. D312, Standard Specification for Asphalt Used in Roofing
 4. D2178, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
 5. D4479, Standard Specification for Asphalt Roof Coatings - Asbestos-Free
 6. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free
 7. D4601, Standard Specification for Asphalt-Coated Glass Fiber Sheet Used in Roofing
 8. D5147, Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material

9. D6163, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements
- B. ASCE-7 Wind uplifts requirements for geographical area.
- C. Federal Specifications (FS)
 1. SS-R-620B
 2. TT-S-00230C
- D. National Roofing Contractors Association (NRCA)
 1. Roofing and Waterproofing Manual
- E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
 1. Architectural Sheet Metal Manual
- F. International Building Code
- G. Underwriters' Laboratories (UL)
 1. Fire Hazards Classifications

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's printed instructions, schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, fastener pattern layout, and accessories to be used in the Work.
- B. Certifications:
 1. Manufacturer's written certification that installer is approved and licensed to install specified roofing system.
 2. Manufacturer's affidavit that materials used in Project contain no asbestos.
 3. Installer shall submit resume and project experience list for proposed system for Project Manager and job site superintendent.
 4. Installer shall submit written certification that there are no undocumented workers being employed by them or by any subcontractor on this project and that all workers on this project are covered by workmen's compensation.
 5. Installer shall submit list of all subcontractors with evidence of subcontractor's insurance coverage in compliance with contract requirements.
 6. Manufacturer's written certification of approval / acceptance of these specifications and details.
 7. Warranty: Submit letter from manufacturer signed by agent authorized to do so, stating acceptance of warranty as specified and detailed.
- C. Referenced Standards: Two (2) copies of each referenced standard and retain approved copies at site.
- D. Shop Drawings: Furnish from copies of the manufacturer's literature or from copies of NRCA "Roofing and Waterproofing Manual", fourth edition.
 1. Furnish for approval any proposed details which differ from those included with this proposal package. All proposed details shall first be approved in writing by roofing manufacturers prior to submitting to Architect for approval.
 2. Furnish detail project sequencing, staging, material loading, manpower plans, and project construction schedule for approval.
- E. Samples:

1. Submit sample copy of job specific warranty that is to be issued upon project completion.
 2. Submit mock-up of all fabricated sheet metal items.
 3. Submit 12-inch x 12 inch sample of all types of roof membranes to be installed.
- F. Temperature Charts: Bitumen heating devices 24-hour temperature charts.
- G. Test Reports: Bitumen manufacturer's test reports relative to the following for each batch of bitumen furnished:
1. Softening Point: ASTM D312.
 2. Flashpoint: ASTM D92.
 3. Acceptable Bitumen Temperature: As recommended by the bitumen manufacturer and EVT label on containers.
 4. Thermometers: Two (2) handheld, "8F" thermometers complying with ASTM E1 to Architect for his checking kettle temperature.
- H. Upon Substantial Completion of Work, submit the following to Architect for his submission to Owner:
1. Manufacturer's Warranty: Manufacturer's written warranty as specified.
 2. Maintenance Procedures: Three (3) copies of manufacturer's printed instructions for Owner's use regarding care and maintenance of roof.

1.6 PROJECT CONDITIONS

- A. Weather Condition Limitations: Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements. Roofing application with moisture present will not be accepted. Do not attempt construction of the roofing system when the reported or calculated dew point are within three (3) degrees of each other
- B. Do not allow waste products, petroleum, grease, oil solvents, mineral oil, and other contaminants to come into contact with the roofing system before or during installation. Advise Owner if there is a possibility of his facility emitting such contaminants in the future.

1.7 INSPECTIONS / TESTS

- A. The Architect's and Manufacturer's representative shall at all times have access to the job site and work areas. The contractor will provide proper and safe facilities for such access and inspection.
1. Architect Inspections: The Architect will be providing periodic inspections throughout the duration of the project. Architect's Representative shall be required to inspect after completion of each major phase of construction for approval.
 2. Manufacturer Inspections:
 - a. An inspection shall be made by a representative of the material manufacturer at appropriate intervals during performance of Work to ensure that said project is installed in accordance with the manufacturer's specifications and illustrated details. Written reports by the manufacturer shall be turned over to the Architect, on each Monday following the prior week.
 - b. The authorized material manufacturer's field representative shall be responsible for:
 - 1) Keeping the Architect's representative informed after periodic inspections as to the progress and quality of the work observed.

- 2) Calling to the attention of the contractor those matters observed which are considered to be in violation of the contract requirements.
 - 3) Reporting to the Architect's representative, in writing, any failure or refusal of the contractor to correct unacceptable practices called to his attention.
 - 4) Confirming, after completion of the work and based on his observation and test, that he has observed no application procedures in conflict with these specifications.
- B. Any failure by the Architect's or Manufacturer's Representative to detect, pinpoint, or object to any defect or noncompliance of these specifications of work in progress or completed work shall not relieve the contractor, or reduce, or in any way limit, his responsibility of full performance of work required of him under these specifications.
- C. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM standard procedures.
1. Owner will select testing laboratory and will pay for Work required by testing laboratory.
 2. Re-tests for work which fail initial tests or inspections shall be paid by contractor.
 3. Noncompliance with contractor requirements will result in the Architect/Owner to assign full time quality control and will be subject to reimbursement by the construction manager/contractor.

1.8 QUALITY ASSURANCE

- A. Applicator:
1. Applicator shall have approval by manufacturer of accepted roofing system for application and issuance of specified warranty for a minimum of three (3) years. Proof of license agreement dated at least three years prior to date of bid opening.
 2. Applicator shall be an experienced single firm specializing in the type of roofing and sheet metal work specified, with a minimum of five (5) years of previous successful experience on projects similar in size and scope.
 3. No subcontracting of sheet metal fabrication or installation will be accepted. Contractor must have a sheet metal shop on the company premises.
 4. Applicators shall have a competent Superintendent, who is not actually performing roofing work, on site at all time while work is in progress, with full authority to act on behalf of the Contractor as his agent.
 5. All workmen shall be covered by Workmen's Compensation insurance (verify upon request) and thoroughly experienced in the particular class of work upon which employed. Use of undocumented workers will not be tolerated - No Exceptions.
 6. Contractor shall ensure that base fastener pull out resistance tests on existing decks were performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.
 7. Roofing contractor must have reached the highest level of qualifications from the manufacture they are providing material for (i.e. Master Select contractor).
- B. Regulatory Requirements:
1. Classification by Underwriters' Laboratories, Inc. as a Class A roof covering.

2. Roofing system shall be installed in accordance with ASCE-7 wind uplift requirements for geographical location exposure C, 115 MPH 3-second gust wind speed zone and an importance factor of 1.15 based on IBC building code requirements. Wind-resistance loads listed below have a safety factor of 2.0 incorporated into the calculation.
 - a. Zone 1 Field – 42.0psf or as otherwise indicated by Structural
 - b. Zone 2 Perimeter – 71.0psf or as otherwise indicated by Structural
 - c. Zone 3 Corner – 105.0psf or as otherwise indicated by Structural
3. Follow local, state, and federal regulations of safety standards and codes. Refer to applicable building code or International Building Code for roofing system installation requirements and limitations.

C. Laboratory Testing and Samples:

1. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM procedures.
2. Owner will select testing laboratory and will pay for Work required by testing laboratory. Contractor shall assume all costs for extraction and patch of all samples.
3. Re-tests for work which fail initial tests or contractor shall pay inspections.
4. Contractor shall correct all deficiencies in accordance with manufacturers recommended procedures at no cost to Owner.

D. Installation:

1. Unless otherwise indicated, the materials to be used in this specification are those specified and denote the type, quality, performance, etc. required. All proposals shall be based upon the use of the specified material.
2. Install materials in accordance with the manufacturer's current published application procedures and the general recommendations of the National Roofing Contractors Association.
3. It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of it. Any drawings supplied are for reference only.
4. Contractor shall plan and conduct the operations of the work so that each section started on one day is complete, details installed and thoroughly protected and in watertight condition before the close of work for that day.
5. Materials will be securely fastened in place in a watertight, neat, and workmanlike manner. All workmen shall be thoroughly experienced in the class of work upon which employed. Work shall be performed in accordance with these specifications and shall meet the approval in the field of the Architect.
6. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust and shall be deposited at an approved disposal site. At completion, all work areas shall be left broom clean, and all contractors' equipment and materials removed from the site.

1.9 PERFORMANCE REQUIREMENTS

- A. Fire Resistance: Meet Underwriter's Laboratory Class "A" fire rating.
- B. Contractor shall ensure that base fastener pull out resistance tests on structural roof deck are performed and approved by Architect and coordinated with Roofing Consultant prior to starting roofing application.

1.10 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 – Project Management and Coordination.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original unopened packaging with all tags and labels intact and legible. Carton and can labels shall indicate appropriate warnings, storage conditions, lot numbers, and usage instructions. Handle and store materials and equipment in such a manner as to avoid damage. Coordinate material storage with school Principal.
- B. Manufacturer's packaging and/or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be minimum acceptable for exterior coverings. All materials stored as above shall be minimum of four (4) inches off the substrate, and the tarpaulin tied off with rope.
- C. Products liable to degrade because of being frozen shall be maintained above 40 degrees F in heated storage.
- D. Moisture sensitive products shall be maintained in dry storage areas or properly covered. Roofing insulation and felts must always be covered or stored in a dry area when not being used.
- E. The proper storage of materials is the sole responsibility of the contractor. Materials damaged in shipping or storage shall not be used. Wet or damaged roofing materials shall be discarded, removed from job site, and replaced with new materials prior to application.
- F. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.12 PRECAUTIONS

- A. Some of the indicated materials are extremely flammable and/or toxic. Use precautions indicated on can and carton labels.
- B. Due caution should be exercised so as not to alter the structural integrity of the deck. When cutting through any deck, care should be taken so as not to damage the deck or any part of the deck, such as post tension cables, etc.
- C. If torches are used, Contractor shall maintain a three (3) hour fire watch after completion of torching of each day's work. Provide a 20 lb. fire extinguisher near torch at all times. Use a thermal infrared thermometer to monitor all roof areas.
- D. The contractor is to verify the location of all interior ducts, electrical lines, piping, conduit, and/or similar obstructions. The contractor is to perform all work in such a manner as to avoid contact with the above-mentioned items.

1.13 WARRANTY

- A. Roofing Manufacturer: Warrant the roofing and associated Work for 20 years from date of Substantial Completion as follows:

1. The warranty shall be a NDL “No Dollar Limit” / no penal sum type, with total replacement cost.
 2. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
 3. The roof system shall include roof insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
- B. Roofing Contractor: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the manufacturer for the remaining three (3) years.
- C. Make arrangements with the materials manufacturer to provide required inspections for issuance of warranty. Final warranty shall be submitted to Owner at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer.
- B. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.
- C. All materials used on the project shall be asbestos free.

2.2 APPROVED PRODUCTS / MANUFACTURERS

- A. Unless noted otherwise, specifications are based on products of named manufacturers but should not preclude the Contractor from using other manufacturers who produce products that meet or exceed the specifications. Manufacturers whose products meet or exceed the specifications, who have manufactured and installed roof materials and systems of the type specified for a minimum of ten (10) years, and who maintains a single source responsibility for the total roofing system, as described herein, may apply for approval as a substitution in accordance with Division 1 requirements regarding substitutions.
 1. All materials shall be manufactured, specified, or accepted in writing by membrane manufacturer issuing the warranty. Proposed materials shall ensure full system warranty from said manufacturer. Installer shall be an applicator licensed by the manufacturer.
 2. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to starting work.
 3. All materials used on the project shall be asbestos free.

- B. Approved Manufactures:
1. Siplast, Inc., Irving, Texas; (972) 869-0070
 2. Soprema, Wadsworth, OH; (800) 356-3521
 3. Firestone Building Products Company, Carmel, IN; (800) 428-4442
 4. Johns Manville, Denver, CO; (800) 654-3103
 5. GAF, Parsippany, NY; 973-628-3000

2.3 ROOF MEMBRANE ASSEMBLY

- A. System Description: A roof membrane assembly consisting of two (2) plies of a prefabricated, reinforced, homogeneous polymer modified asphalt membrane, secured to specified insulation or substrate. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system. Contractor option to install using hot asphalt “mopped”, cold adhesive, torched, or any combination – confirm special membrane types with manufacturer. Provide components of the roof membrane assembly meeting the following physical and mechanical requirements.

1. **Hot Asphalt Applied Modified Bitumen Base Ply:** Approximately 90 mil high performance modified bitumen base ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality modified bitumen and having the following properties:
 - a. Approved Product:
 - 1) Siplast Product: Paradiene 20
 - 2) Soprema Product: Elastophene Sanded 2.2
 - 3) Firestone Product: SBS Base
 - 4) JM Product: DynaBase
 - 5) GAF Product: Ruberoid 20 Smooth
2. **Torch Applied Modified Bitumen Base Ply:** Approximately 120 mil high performance modified bitumen base ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality modified bitumen and having the following properties:
 - a. :
 - 1) Siplast Product: Paradiene 20 TG
 - 2) Soprema Product: Elastophene Flam
 - 3) Firestone Product: SBS Glass Torch Base
 - 4) JM Product: DynaWeld Base
 - 5) GAF Product: Ruberoid Torch Smooth Membrane
3. **Hot Asphalt Applied Modified Bitumen Finish Ply:** Approximately 130 mil or better high-performance modified bitumen “cool roof” reflective white finish ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality Styrene-Butadiene-Styrene (SBS) modified bitumen, and having the following properties:
 - a. Approvals: UL Approved, FM Approved (products shall bear seals of approval)
 - b. Surfacing: White synthetic chips
 - c. Solar Réflectance (avg.) : greater than 3 years aged .75
 - d. Thermal Emittance (avg.): greater than 3 years aged .75
 - e. Solar Reflectance Index (avg.): greater than 3 years aged 64

- f. Approved Product:
 - g. 1) Siplast Product: Paradiene 30 FR BW
 - h. 2) Soprema Product: Elastophene LS FR GR SG
 - i. 3) Firestone Product: SBS Glass FR Ultrawhite
 - j. 4) JM Product: DynaGlas FR CR G
 - k. 5) GAF Product: Ruberoid 30 Granule FR

- 4. **Torch Applied Modified Bitumen Finish Ply:** Approximately 140 mil (or more) high performance modified bitumen “cool roof” reflective white finish ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality Styrene-Butadiene-Styrene (SBS) modified bitumen, and having the following properties:
 - a. Approvals: UL Approved, FM Approved (products shall bear seals of approval)
 - b. Surfacing: White synthetic chips
 - c. Solar Reflectance (avg.) : greater than 3 years aged .75
 - d. Thermal Emittance (avg.): greater than 3 years aged .75
 - e. Solar Reflectance Index (avg.): greater than 3 years aged 64
 - f. Approved Product:
 - 1) Siplast Product: Paradiene 30 FR TG BW
 - 2) Soprema Product: Elastophene Flam LS FR GR SG
 - 3) Firestone Product: SBS Glass FR Torch Ultrawhite
 - 4) JM Product: Dynaweld Cap FR CR
 - 5) GAF Product: Ruberoid EnergyCap Torch Plus Granule FR Membrane

- 5. Stripping Ply: Same as roof system base ply.

2.4 FLASHING MEMBRANE ASSEMBLY

- A. A flashing membrane assembly consisting of two (2) plies of reinforced, polymer modified asphalt membrane (foil face flashing membrane can be used as substitute):
 - 1. Modified Bitumen Flashing Sheet: Same as roof system finish ply.

 - 2. Modified Bitumen Foil Faced Flashing Sheet (Substitute):
 - a. Siplast Product: “Aluminum” Veral
 - b. Soprema Product: Sopralast 50 TV “Alu”
 - c. Firestone Product: SBS Metal Flash AL
 - d. JM Product: DynaClad AL
 - e. GAF Product: Ruberoid UltraClad SBS Membrane

 - 3. Reinforcing Ply: Same as roof system base ply.

2.5 ROUGH CARPENTRY

- A. All nailers, cants and wooden curbs shall be No. 2 or better treated lumber selected to meet design details and field dimensions and requirements of Section 06 10 00, Rough Carpentry. MCQ and MCA only.

2.6 ROOFING SHEET METAL

- A. Refer to Section 07 62 00, Roof Related Sheet Metal.

2.7 ROOF INSULATION

- A. Roofing Insulation:
1. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application with UL and FM Global approval.
 2. Polyisocyanurate Roof Insulation: Shall comply with ASTM C1289 Type II Class 2 coated polymer bonded glass fiber mat facer on both sides, with a 20-psi minimum compressive strength. Thickness shall be a minimum total of 5.2" (or size specified on drawings) and divided in two staggered layers. Approved product shall be RESISTA as manufactured by Firestone Building Products or pre-approved substitute.
 3. Recover Board (Unless noted otherwise): Glass-Faced Gypsum Roof Board equal to UL rated Type X "Dens Deck Prime" as produced by Georgia-Pacific. Board sizes shall be 48" x 96" x 1/2" or as indicated on drawings for roof assembly. 1/4" SOPRABOARD is approved substitution with Soprema roofing system. Provide as required by manufacture recommendation primer for Roof System. Approved substitute, SECUROCK by USG.
 4. Tapered Insulation: Factory cut 48 inches x 48 inches polyisocyanurate board; slope and thickness to vary as required to achieve a minimum 1/4" per foot finished slope unless noted otherwise on the Drawings (cricketed areas between roof drains / scuppers are to achieve a minimum 1/2" per foot slope); ASTM C1289 Type II Class 2 coated polymer bonded glass fiber mat facer on both sides, with a 20-psi minimum compressive strength. Approved product shall be tapered RESISTA as manufactured by Firestone Building Products or pre-approved substitute. Provide 1/2-inch cover board similar to that specified above over tapered polyisocyanurate board insulation.
 5. Tapered Edge Strip: 1-1/2 inches to 0 inches (or as required, field verify), 18 inches x 48 inches, install at all expansion joints, curbs, projections, crickets, saddles, and base flashings. Approved material shall be as manufactured by Cant Products or pre-approved equal.

2.8 ROOFING ACCESSORIES

- A. Roofing Adhesives:
1. Mopping Asphalt: Asphalt that has been certified for full compliance with the requirements for Low Fume Type IV asphalt listed in Table I, ASTM D312. Each container or bulk shipping ticket shall indicate the equiviscous temperature EVT, the finished blowing temperature, FBT, and the flash point, FP.
 - a. Approved Product: Trumbull Low Fume asphalt or as required by membrane.
 2. Cold Adhesive (if applicable): An asphalt-based adhesive formulated especially for adhering polymer modified asphalt roofing membranes and base plies. Adhere shall be UL & FM listed and approved.
 - a. Soprema Product: FMA
 - b. Siplast Product: PA-311 Adhesive
 - c. Firestone Product: MB Cold Adhesive
 - d. JM Product: MBR Cold Application Adhesive
 - e. GAF Product: MATRIX 101 Premium SBS Membrane Adhesive
- B. Bituminous Cutback Materials:
1. Primer: A high flash, quick drying, asphalt solvent blend which meets or exceeds ASTM D41 requirements.

2. Plastic Cement: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges and conforming to ASTM D4586 Type II requirements.
 3. Flashing Cement: A heavy-bodied all-weather trowel grade mastic, used as a base for laying-up cold process flashing membrane where fast setting adhesives are required.
- C. Sealants: A single component, high performance, elastomeric sealant conforming to ASTM D232 or ASTM C920 requirements. Acceptable types are as follows:
1. Sonolastic NP 1 manufactured by Sonneborn Building Products; Minneapolis, MN (612) 835-3434
- D. Ceramic Granules: No. 11 Grade Specification Ceramic granules of color scheme matching the granule surfacing of the finish ply.
- E. Walkpads / Protection Pads: Provide cut sections of granule surfaced polyester reinforced modified bitumen sheet, such as “Dyna Tred Plus”.
1. Walk pads shall have contrasting granule color from surfacing.
 2. Provide walk pads shall be installed at point of roof access, at service points of all roof mounted equipment requiring periodic maintenance.
 3. Protection pads shall have rounded corners and extend minimum four (4) inches beyond edge of overlying element.
 4. Provide new protection pads under all pipe supports, at HVAC and mechanical access points, in front of all roof top doors and openings.
- F. Fasteners:
1. Shall be Factory Mutual approved and as recommended by the manufacturer for the specific application.
 2. Fastener for Brick: Shall be 1/4-inch x 2 inches, stainless steel nail, one piece unit, flat head, as manufactured by Rawl Zamac Nailin, or approved equal.
 3. Fastener for Wood and Insulation (over steel decks): Shall be a minimum #14 Factory Mutual approved fastener, fluorocarbon coated, with CR-10 coating. A minimum 0.200-inch diameter shank and 0.250-inch diameter thread. To be used with Factory Mutual approved, round pressure plates or bar, and having a fluorocarbon CR-10 coating, when subjected to 30 Kesternich cycles (DIN 50018) shows less than ten percent (10%) red rust which surpasses Factory Mutual Approval Standard 4470 as manufactured by Olympic Manufacturing Group, Inc., or pre-approved equal. Stainless Steel 304 when used with ACQ treated lumber.
 4. Nails: Stainless Steel ring shank, size as required to suite application, minimum 11 gauge with 3/8-inch diameter head.
 5. Iron-Lok Toggle: Shall be a toggle bolt with minimum 0.215-inch diameter shank and minimum 20 threads per inch, with a 2-1/2 inch wingspan, with wing activated adhesive and pressure plate, as manufactured by Olympic Manufacturing Group, Inc.
- G. Liquid Flashings: One-Part Liquid Flashing is a one-component polyurethane / bitumen resin that provides a liquid flashing solution for asphaltic roofing systems. Utilize fabric in three-part system at all penetrations.

2.9 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Other materials shall be as shown, specified, or required and be of the best grade for the proposed use as recommended by the manufacturer.

1. Expansion Joint: As detailed on drawings and outlined in NRCA and SMACNA manuals.
2. Low Level expansion joints, as noted on the drawings, to be fabricated similar to Situra Inc. "Red Line" Low level expansion joint details. Install as per manufactures recommendations.
 - a) Approved Substitute Soprema's "Sopra Joint". Install as per manufactures recommendations.
3. Sealant Backer Rod: Provide compressible rod stack of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable, non-absorptive material as recommended by sealant manufacturer for back-up of and compatibility with sealant. Where used with hot-applied sealant, provide heat-resistant type which will not be deteriorated by sealant application temperature as indicated.
4. Pipe Hangers and Supports: Provide and install all necessary supports for gas lines, conduit, chilled water lines, duct work, condensate lines, etc... Refer to Section 07721, Roof Accessories.
5. Cant Strips: Shall be wood fiber were used for non-structural purposes. Shall be treated solid wood were used for structural purposes meeting NRCA, Factory Mutual and Underwriters Laboratory guidelines. If solid wood cant is used where insulation exists, cant is to be toe nailed into treated solid wood nailer the same height as insulation.
6. Termination Bar:
 - a. Material: Extruded aluminum bar with lip profile.
 - b. Size: 0.090 inch thick by 3/4 inch wide with 3/16-inch lip width and a 45 degree lip angle, factory punched 1/4-inch x 3/8-inch oval holes spaced six (6) inches on center.
 - c. Approved Product/Manufacturer: "LIPTB 06" manufactured by Olympic Manufacturing Group, Inc., or approved equal.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

- A. Environmental Requirements:
 1. Apply roofing in dry weather.
 2. Do not apply roofing when ambient temperature is below 45 degrees F.
 3. Refer to manufacturer's recommendations.

3.2 ROOFING AND FLASHING - GENERAL

- A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow installation of insulation as a continuous operation.
- B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials and exercise care in ensuring that the finished application is acceptable to the Owner.
- C. Application of materials shall be in strict accordance with the manufacturer's recommendations except where more stringent requirements are shown or specified. In

the instance of a conflict between these specifications and those of the manufacturer, the more stringent specifications shall take precedence.

D. General Installation:

1. Protect adjacent areas with tarpaulin or other durable materials.
2. Contractor shall prevent overspray and be responsible for parking lot areas and/or adjoining areas not part of this contract.
3. Contractor shall be responsible for sealing, as required, all openings that may allow bitumen migration or drippage, i.e. pitch dams, envelopes, and filler strips.
4. Prepare surfaces according to manufacturer's or applicator's published instructions. All metal that is to receive bitumen, or come in contact with bitumen or adhesive, shall be first primed with appropriate primer. All Kynar 500 or Hylar 5000 finished metal shall be buff sanded on the surface which is to be primed prior to the application.
5. Use cleaning materials or primers necessary to render an acceptable surface/substrate.
6. All surfaces/substrates shall be clean and dry prior to application of materials. Roof deck substrates shall be inspected for moisture in accordance with the manufacturer's recommendations. Architect's representative shall witness inspection. Roofing installed before inspection by Architect's representative shall be removed to allow inspection.
7. Prior to application of felts and membrane, all foreign matter, gravel, etc., shall be removed from the substrate. Gravel or debris between the substrate and plies is not acceptable.
8. Ambient temperature shall be 45 degrees F and rising.
9. Bitumen kettles or tankers shall have a visible thermometer and thermostatic control to provide positive monitoring of the bitumen temperature when it is heated in accordance with manufacturer's instructions. Kettle shall be kept a minimum of 20 feet away from building, placed so that fumes, odors, and smoke, do not enter building through windows, doors, fresh air vents or similar entrances; are not directed towards freshly painted or anodized surfaces, glass or other glazing materials. Do not place kettle under trees or near vegetation. The assigned kettle man shall remain in close attendance, within 25 feet of ground level, while burners are lit. Kettle lids are to remain closed except for loading. Level of bitumen shall be kept within eight (8) inches from top of kettle. All kettles are to have afterburners installed to reduce fume emissions.
10. Asphalt Bitumen Heating: Heat and apply bitumen in accordance with equiviscous temperature method ("EVT Method") as recommended by the manufacturer. Discard bitumen that has been held at temperature, exceeding finished blowing temperature (FBT) for a period exceeding three hours. Do NOT heat bitumen to a temperature higher than 25 degrees F (14 degrees C) below flash point.
11. Asphalt Temperatures: If the EVT information is not provided, the following asphalt temperature shall be observed. Maximum heating temperature shall be 525 degrees F. Minimum application temperature shall be 400 degrees F.
12. Asphalt Moppings: Ensure that all moppings do not exceed a maximum of 25 pounds per square. Mopping shall be total in coverage, leaving no breaks or voids.
13. Membrane Adhesive Application: Apply cold adhesive in a smooth, even, continuous layer without breaks or voids at the rate of 1-1/2 gallons per square per ply. (The porosity of some substrates may require a heavier application to ensure full adhesion.)
14. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
15. Circulate bituminous materials, do not allow bituminous materials to stand in luggers for long periods. Use insulated hot transport lines and luggers.

16. Keep kettle lid closed except when adding bitumen.
17. Wrinkles, buckles, kinks, and fishmouths are not acceptable when laying felt and membrane.
18. Dry voids of felt on felt are not acceptable.
19. Primed cant strips shall be installed at the intersection of the deck and the vertical surfaces.
20. All flashings shall be mechanically top-fastened with a termination bar a minimum of six (6) inches on center at the top leading edge, and be a minimum of eight (8) inches in height above the finished membrane height.
21. On slopes greater than one (1) inch in 12 inches, refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.
22. Correct all errors in application the same work day they occur, including voids, fishmouths, dry laps or spots, wrinkles, ridges, blisters, bare spots, improper application, physical damage and all work not meeting specifications.
23. Follow manufacturer's recommendation for application of cold adhesive due to slope requirements.

3.3 NAILERS

- A. Wooden nailers shall be installed at perimeter edges or drip edges on outside perimeter of building in accordance with FM Global 1-49 securement requirements. All deck penetrations (soil stacks, mechanical curbs, etc.) shall receive wooden nailers stacked minimum 3/4 inch above designed deck thickness.
- B. All Construction: Nailers shall be the same height as the finished height of the insulation layer. Nailers shall be anchored to resist a pull-out force of 175 pounds per foot. Fasteners shall be no less than two (2) per nailer and be spaced at three (3) feet on center maximum or as required by FM Global 1-49 requirements. Provide nailers at all penetrations. Install / Raise all curbs, etc. a minimum of ten (10) inches above roof deck.

3.4 SUBSTRATE PREPARATION

- A. Substrate Surface: Prepare substrate surfaces to insure proper and adequate installation, in strict accordance with the Contract Documents and approved Shop Drawings, or manufacturer's requirements.
- B. Fill all gaps and voids between substrate components that are wider than 1/4 inch. Fill all gaps with same materials as the substrate.
- C. The membrane manufacturer shall specify types of substrates that are suitable for use with the bonding adhesive.
- D. Protection of Adjacent Areas or Surfaces: Protect adjacent areas or surfaces from damage as a result of the Work of this section. Remove sharp projections.
- E. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- F. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.5 APPLICATION OF INSULATION

- A. General:
1. Manufacturer's Instructions: In regard to attachment, the manufacturer's instructions or specifications shall determine the suitability for an application.
 2. Precautions: The surface of the insulation must not be ruptured or damaged prior to installation of the roof membrane. Replace damaged boards.
 3. Thermal insulation boards shall be laid on the substrate in parallel rows with end joints staggered and butted as close as possible. All joints shall be tight and at the roof perimeter and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a minimum. All openings 1/4 inch or larger shall be filled with insulation.
 4. Insulation shall be tapered or feathered at drains and scuppers to provide proper drainage (if applicable).
 5. No more insulation shall be installed than can be covered by the completed roof system by the end of the day or the onset of inclement weather.
 6. Tapered insulation and crickets, when specified, shall be placed in accordance with the drawings and/or as required NRCA standards.
- B. (Steel decks); Specified first layer of rigid insulation shall be mechanically fastened to the steel deck meeting ASCE-7 wind uplift requirements as dictated by wind zone applicable to location of project. Fasteners and fastening patterns shall be determined by building height, location, and geographical area of the United States. It is the contractor's responsibility to consult current publications, literature, and bulletins of current codes and the manufacturer that are in effect at the time of this project.
- C. For subsequent layer or layers of insulation or specified recovery board, the top surface of the underlying layer of insulation shall be coated with hot asphalt using a minimum of twenty-five pounds (25#) per one hundred (100) square feet of surface, and subsequent layers of insulation shall be applied using offset joints, so that all individual insulation layers joints are offset a minimum of six inches (6") both ways with the preceding layer, and immediately walked in place.

3.6 ROOF MEMBRANE INSTALLATION

- A. Membrane Application: Install roofing in accordance with roofing system manufacturer's current published instructions and the following requirements. Application of roofing membrane components shall immediately follow application of insulation as a continuous operation.
- B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this Project. Make necessary preparations, utilize recommended application techniques, apply the specified materials (i.e. granules, metallic powder, etc.) and exercise care in ensuring that the finished application is acceptable to the Owner.
- C. Adhesive Application: Apply cold adhesive with a spray equipment or squeegee in a smooth even, continuous layer without breaks or voids at the rate of 1 ½ to 2 gallons per

square per ply. (The porosity of some substrates may require a heavier application to ensure full adhesion. Refer to manufacturer's requirements).

- D. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.
- E. Roofing Application: Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets. Lap seams between the base ply layer and the finish ply layer shall not coincide. Stagger the courses to ensure this.
 - 1. Apply all layers of roofing so that water flows over or along lap seams, but never against laps.
 - 2. Attach the base ply to the insulation with cold adhesive, torch or hot asphalt. Each sheet shall have minimum three (3) inch side laps and six (6) inch end laps. Each sheet shall be applied directly behind the adhesive applicator. Stagger end laps a minimum of three (3) feet.
 - 3. Fully bond the finish ply to the base ply with cold adhesive, torch, or hot asphalt. Each sheet shall have a minimum of three (3) inch side and six (6) end laps. Each sheet shall be applied directly behind the adhesive applicator. Stagger end laps of the finish ply a minimum of three (3) feet. Stagger side laps of the finish ply a minimum of 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum of three (3) feet from end laps in the underlying base ply.
 - 4. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes.
 - 5. Lap Treatment: A 20-pound roller shall be used on all side and end laps, following immediately behind application, apply uniform pressure across lap area to achieve a continuous visible bleed out.
- F. Granule Embedment: Broadcast mineral granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot, to ensure a monolithic color and adhesion.

3.7 ROOF FLASHING MEMBRANE INSTALLATION

- A. Flashing - General:
 - 1. Flashings shall be installed using the manufacturer's flashing membrane, with length of run not to exceed manufacturer's recommendations.
 - 2. Wooden nailers or curbs shall be installed at all edges and openings in the roof, mechanically fastened to the deck. The nailers should be of exterior grade wolmanized timber, and of the same thickness as any insulation to be used on the roof.
 - 3. Cant strips shall be installed at the intersection of the deck and/or all vertical surfaces. Prime all cants.
 - 4. The roofing field membrane shall extend up over and to the top of cant strips at all vertical intersections or out to the roof's edge.
 - 5. All substrates receiving flashing membrane shall be clean and primed with asphalt primer, prior to application.
 - 6. All flashings shall be mechanically fastened with a termination bar a maximum of six (6) inches on center, be a minimum of eight (8) inches above finished roof height (seal top with three (3) coursing), extend a minimum of nine (9) inches onto

- the field of horizontal roof membrane, and not exceed ten (10) linear feet of run in length.
7. Install flashing membrane in accordance with drawings and / or material manufacturer's guarantee requirements, whichever is the most stringent.
 8. Exert sufficient pressure on the flashing membrane to ensure the prevention of air pockets. This can be accomplished by using a damp, kitchen type sponge mop or a damp, heavy duty cotton nap paint roller.
 9. Prime all end laps of the flashing membrane with a uniform coating of the specified asphalt primer and allow to thoroughly dry prior to overlapping of adjoining sheets.
 10. Probe laps using a clean, heated roofing trowel and heat fuse dry laps of the flashing membrane to ensure a complete seal.
- B. Flashing Application - Masonry Surfaces: Flash masonry parapet walls and curbs using the reinforcing sheet and the metal foil flashing membrane. After the base ply has been applied to the top of the cant, fully adhere the reinforcing sheet, utilizing minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and three (3) inches up the parapet wall above the cant. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or by application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the metal foil flashing layer from lap seams in the reinforcing layer. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation).
- C. Flashing Application - Wood Surfaces: Flash wood or plywood parapet walls and curbs using the reinforcing sheet and metal foil flashing membrane. The reinforcing sheet shall have minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and to the top of the parapet wall, curb, etc. Nail the reinforcing sheet through the field of the sheet to the vertical wood surface on 12-inch centers from the top of the cant to top of wall curb, etc. Fully adhere the remainder of flashing reinforcing sheet that extends over the cant and roof level. After the finish ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation).
- D. Projection Flashings:
1. Plumbing Vents: Soil vent stack pipes shall receive lead flashings installed in accordance with practices set forth in the NRCA Roofing Manual. The lead shall be carried up and over the top of the stack and crimped down into the pipe to form a watertight seal. Projections shall be flashed as recommended by the roof

- membrane manufacturer. Strip-in flange with specified stripping ply and cap with finish ply. Provide flashing membrane target.
2. Square Projections: Strip in all flanges on square projections with specified stripping ply and cap with finish ply. Provide flashing membrane target. Provide tapered edge strips around base. Cricket up-side slope.
 3. Prime all flanges prior to setting in a bed of mastic. Install to manufacturer's specifications. Provide tapered edge strips around base as required. Cricket up-side slope.
 4. Round Projections: Strip in all flanges on round projections with specified stripping ply and cap with finish ply. Provide flashing membrane target.
 5. Prime all metal prior to setting in mastic. Install to manufacturer's specifications.
- E. Wall and Curb Flashings:
1. The flashing substrate shall be free of all dirt and loose material.
 2. $\frac{3}{4}$ " plywood is to be used at all parapets that receive wall flashings.
 3. The underlayment ply or plies shall be brought to the top of the cant strip and adhered.
 4. Starting on the roof at least six (6) inches from the roofside edge of the cant strip, adhere two (2) plies of flashing extending over the cant and up the vertical a minimum of eight (8) inches. Each lap of the ply sheet shall be a minimum of three (3) inches.
 5. Starting two (2) inches past the flashing plies, install one (1) ply of SBS flashing membrane in hot asphalt. Laps shall not coincide with previously installed plies. The top of the SBS flashing shall be one (1) inch past the previously installed plies above the cant strip.
 6. Fasten the top edge of the flashings on six (6) inch centers using approved termination bar and fasteners.
 7. An NRCA-approved metal counterflashing shall extend down over the flashing a minimum of four (4) inches.
 8. Cricket the up-side slope at all curb projections.
- F. Perimeter Edge Flashing: Refer to Section 07 62 00.
- G. Bleed out of flashing membrane: Broadcast bulk aluminum powder over all bitumen overruns on the flashing membrane surface while the bitumen is still hot to ensure a monolithic surface color. With approval of manufacturer, a premium glossy aluminum paint may be used.

3.8 OVERNIGHT SEAL / WATER CUT-OFF

- A. Over Night Seal: Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual.
- B. Water Cut-Off: At the end of day's work or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to resumption of roofing.

3.9 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS

- A. The following is a list of descriptions for correct installation of components integrated into the roof membrane assembly. In all cases, unless otherwise approved, incorporate flanged components into the system between the applications of the base ply and finish ply. The

flange must be primed with a uniform coating of approved ASTM D41 asphalt primer and allowed to dry thoroughly; all flanges must be set in approved mastic.

- B. Sealant: Caulk all exposed finish ply edges at gravel stops, waste stacks, pitch pans, vent stacks, etc., with a smooth continuous bead of approved sealant.
- C. Sheet Metal: Refer to Section 07 62 00, ROOF RELATED SHEET METAL.

3.10 FIELD QUALITY CONTROL AND INSPECTIONS

- A. Roof cuts shall be performed and repaired at contractor's expense. Cuts shall be made in the areas as indicated by the Architect's representative. Send required roof cuts to roof membrane manufacturer for laboratory examination. Roof cuts required by the Architect's representative shall be furnished to the Architect's representative for testing.
- B. Remove not more than one (1) 12-inch x 12-inch cut per 5,000 square feet of roof area or fraction thereof.
- C. Field audit will follow criteria outlined in current roof membrane manufacturer's Reference Manual.
- D. Repair sampled areas with "feathered in" patch consisting of same number of plies as in the roof specification.
- E. Correct deficiencies in roof as prescribed in current roof membrane manufacturer's Reference Manual and as approved by Architect's Representative.

3.11 CLEANING AND PROTECTION

- A. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean and shall allow no roofing materials to remain on the outside walls.
- B. Leave all areas around job site free of trash, debris, roofing materials, equipment, and related items after completion of job.
- C. All bituminous or roofing related materials shall be removed from ladders, stairs, railings, and similar parts of the building.
- D. Remove bitumen stains from walls, walkways, and driveways.

END OF SECTION 07 52 19

SECTION 07 62 00 - ROOF RELATED SHEET METAL

PART I – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. It is the intent of this Section that the Work shall:
 - 1. conform to all applicable building code requirements and of authorities having jurisdiction;
 - 2. include all shop and field formed sheet metal work shown on drawings, specified or required, including, but not limited to:
 - a. Roof penetration sleeves and hood and umbrella counterflashing
 - b. Metal counterflashing
 - c. Expansion joint
 - d. Roof drains
 - e. Scuppers
 - f. Metal perimeter edge
 - g. Gutters, Downspouts, Splash Blocks and Splash Pans
 - h. One-way roof moisture relief vents
 - i. Metal gravity vents
 - j. Metal heat exhaust vents
 - k. Sanitary vent pipes
 - l. Pipe box
 - m. Copings, trim and miscellaneous sheet metal accessories.
 - 3. be part of the Work of the Roofing System; and
 - 4. be performed by a single source contractor.

1.3 RELATED WORK

- A. Section 07 52 19 - Modified Bitumen Membrane Roofing System
- B. Section 07 52 19 - Modified Bitumen "Cool Roof" Membrane Roofing System
- C. Section 07 54 23 – Mechanically Attached Thermoplastic Single Ply Membrane Roofing System
- D. Section 07 54 19 – Fully Adhered Thermoplastic Membrane Roofing System
- E. Section 07 72 00 – Roof Accessories
- F. All Sections of Work relating to or affecting the roofing system, including mechanical, plumbing and electrical items.

1.4 REFERENCES

- A. ASTM International (ASTM)
 - 1. A525, Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 - 2. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

3. B32, Standard Specification for Solder Metal
 4. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- B. ASCE 7
- C. Federal Specifications (FS)
1. QQ-L-201 for lead
- D. National Association of Architectural Metal Manufacturers (NAAMM)
- E. National Roofing Contractors Association (NRCA)
1. Roofing and Waterproofing Manual
- F. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
1. Architectural Sheet Metal Manual
- G. ANSI / SPRI ES-1

1.5 SUBMITTALS

- A. Product Data:
1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 2. Manufacturer's installation instructions.
- B. Shop Drawings: Indicating sizes, configurations, details of attachment to related and adjacent work, materials, and finishes.
- C. Samples:
- 1) Full range of finish colors for Architect's selection.
 - 2) 12 inch long sample of each specified item with approved finish.
 - 3) Provide full size mockup of all shop built assemblies.
 - 4) Documentation of Wind uplift requirements for Roof Edge for specific project location
 - a. Wind Calculator available online

1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Fabricator and installer of roof-related flashing, installer of prefabricated edge metal and accessories shall be the same as the membrane roof installer.
- B. Comply with governing codes and regulations of authorities having jurisdiction.
- C. ANSI / SPRI ES-1: Install sheet metal edge flashings and copings to comply with requirements of ANSI / SPRI ES-1 / FM 1-49 for minimum of up to 160 MPH wind speed zone and wind resistance loads.

1.7 INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13, Project Coordination.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver, handle and store materials in accordance with manufacturer's instructions.
- B. Handle and store materials and equipment in such a manner as to avoid damage.
- C. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

1.9 WARRANTIES

- A. Manufacturer's Product Warranty:
 - 1) Manufacturer's standard 30 year Kynar 500 or Hylar 5000 Finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
 - 2) Failure is defined to include, but not be limited to:
 - a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
 - 3) Wind Warranty
 - a. Non Coastal: up to 160 MPH Blow Off Resistance, 20 Year
 - 4) Correction may include repair or replacement of failed product as outlined in Warranty Documents
 - 5) Finish warranty and wind warranty shall be delivered by Roofing Contractor to Owner at the conclusion of project as part of project closeout documents.
- B. Roofing Contractor's Warranty:
 - 1. Contractor shall warrant the installation and related work to be free from defects in workmanship and materials, and that the metal flashings will be and remain watertight and secure, for a period of five (5) years from date of Substantial Completion.
 - 2. Defects shall include, but not be limited to:
 - a. Leaking water on the exterior of the building, causing staining or discoloration of wall / exterior surface.
 - b. Leaking water or bitumen within building or construction.
 - c. Becoming loose from substrate / blocking.
 - d. Loose or missing parts.
 - e. Finish failure as defined above.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Metal Era, Inc., which is located at: 1600 Airport Rd.; Waukesha, WI 53188; Toll Free Tel: 800-558-2162; Tel: 262-549-6900; Fax: 800-373-9156; Email:[request_info \(info@metalera.com\)](mailto:request_info@metalera.com); Web:www.metalera.com
- B. Substitutions: Before proposal date upon roof consultant approval.
- C. Requests for substitutions will be considered in accordance with provisions of Section 012513.
- D. Manufacturers named within specification are approved for use on the Project providing:
 - 1. their products meet or exceed the specifications;

2. company has a minimum of five (5) years' experience manufacturing products of the type specified;
3. products have been tested in conjunction with roofing membrane system as an assembly and as such has obtained the same approval and rating as the roofing membrane system; and
4. products are approved for use by the roofing membrane manufacturer.

2.2 SHEET METAL MATERIALS

- A. General Requirements: Roofing sheet metal system shall have been tested in conjunction with roofing membrane system as an assembly and have the same approval and rating as the roofing membrane system.
- B. Prefinished Galvanized Sheet Steel:
 1. Commercial quality ASTM A527 G-90 hot-dip galvanized coating designation.
 2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
 3. Finish: Kynar 500 or Hylar 5000 in color as selected by Architect from manufacturer's full range of] colors.
- C. Membrane Clad Sheet Steel:
 1. Commercial quality ASTM A527 with G-90 hot-dip galvanized coating designation.
 2. Thickness: Except as otherwise indicated, minimum 24 gauge. SMACNA recommendations shall govern.
 3. Finish: PVC / TPO coating as per Membrane Manufacturer's requirements.
- D. Sheet Lead:
 1. Comply with FS QQ-L-201, Grade B
 - a. Four (4) pound minimum for use at roof drains and soil stacks.
- E. Stainless Steel: ASTM A167, Type 302 / 304 Soft Temper, No. 2D finish. Minimum thickness 24 gauge, except as otherwise noted.

2.3 FASTENERS

- A. Same metal as flashing / sheet metal or other non-corrosive metal or as noted below.
- B. Exposed fasteners shall be self-sealing and gasketed (ZAC type) for weathertight installation.
- C. Match finish of exposed heads with material being fastened.
- D. Mechanical Fasteners:
 1. Nails: Ring shank, minimum 1-1/2 inches in length with 1/2 inch diameter head.
 2. Washers: Steel washers with bonded rubber sealing gasket.
 3. Screws: Self-tapping sheet metal type of stainless steel or compatible with material being fastened, with hooded integral EPDM washers (ZAC type).
 4. Rivets: Stainless steel and cadmium plated material, closed end type of sizes recommended by sheet metal manufacturer to suit application.
- E. Clips:
 1. Cleat (coping / fascia): Minimum 22 gauge, G-90 galvanized, stainless steel, or aluminum. Match material of coping / fascia and provide one (1) gauge heavier.

2.4 RELATED MATERIALS

- A. Solder: ASTM B32, alloy grade 58, 50 percent tin, 50 percent lead.
- B. Flux:
 - 1. Phosphoric acid type, manufacturer's standard.
 - a. For Use with Steel or Copper: Rosin flux
 - b. For Use with Stainless Steel: Acid-chloride type flux, except use rosin flux over tinned surfaces.
- C. Underlayment:
 - 1. At expansion joints: to be used as bellow; 48 mil minimum, non-reinforced, homogeneous, waterproof, impermeable elastomeric sheeting manufactured by Nervastral, Inc. or Lexsuco.
 - 2. At wood blockings: Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by manufacturer and coordinate with specification 07 65 00.
- D. Adhesives: Type recommended by flashing sheet manufacturer seaming and adhesive application of flashing sheet to ensure adhesion and watertightness.
- E. Metal Accessories: Sheet metal clips, straps, anchoring devices, clamps and similar accessories required for the complete installation of work, matching or compatible with material being installed, non-corrosive, size and gauge recommended by installer to suit application and performance.
- F. Sealant:
 - 1. Type A:
 - a. Type: One-part, non-sag, moisture-curing polyurethane sealant.
 - b. Approved Products / Manufacturers: "Chem-Calk 900" manufactured by Bostik Construction Products Division, "Vulkem 921" manufactured by Mameco International, Inc., "Dynatrol I" manufactured by Pecora Corporation, "MasterSeal NP 1" manufactured by BASF, or approved equal.
 - 2. Type B:
 - a. Type: One-part, neutral-curing, medium-modulus silicone sealant for sealing metal to metal surfaces, i.e. metal edge, cover plates, etc.
 - b. Approved Products / Manufacturers: "Chem-Calk 1200" manufactured by Bostik Construction Products Division, "795 Silicone Building Sealant" manufactured by Dow Corning Corporation, "895 Silicone" manufactured by Pecora Corporation, "Omniseal" manufactured by Sonneborn Building Products, "Spectrem 2" manufactured by Tremco Incorporated, or approved equal.
- G. Grout - Pitch Pans:
 - 1. Type: Quick-setting, non-shrink, non-metallic, high strength formula complying with ASTM C1107.
 - 2. Approved Products / Manufacturers: "Sure Grip High Performance Grout" manufactured by Dayton Superior Corporation, "Premier Quick-Trim" manufactured by L & M Construction Chemicals, Inc., "MasterFlow" manufactured by BASF, or approved equal.
- H. Pitch Pan Filler:
 - 1. Type: Pourable polyurethane sealer, approved by roofing system manufacturer.

2. Approved Products / Manufacturers: "Quick Pitch Sealer" manufactured by U.S. Intec, "SPM Pourable Sealer" manufactured by Johns Manville, or approved equal.
- I. Termination Bar:
 1. Material: Stainless steel or extruded aluminum bar with lipped profile.
 2. Size: 1/8 inch thick by one (1) inch wide with factory punched 1/4 inch x 3/8 inch oval holes spaced six (6) inches on center.
 3. Approved Product / Manufacturer: "TB 125" manufactured by TruFast Corp., or approved equal.
- J. Pipe Hangers and Supports: Refer to Section 07 72 00, Roof Accessories.
- K. Splash Blocks: Concrete type, of size and profiles indicated; minimum 3,000 psi compressive strength at 28 days, with minimum five (5) percent air entrainment. Use at locations where roof drainage discharges on ground.
- L. Splash Pans: 22 gauge stainless steel, of size and profiles indicated. Use at locations where roof drainage discharges over adjoining, lower roof level(s).

2.5 FABRICATION

- A. Except as otherwise indicated, fabricate work in accordance with SMACNA Architectural Sheet Metal Manual and other recognized industry practices and reviewed shop drawings. Form all flashings, receivers and counterflashings in accordance with standards set forth in the NRCA roofing manual and SMACNA.
- B. Comply with manufacturer's installation instructions and recommendations.
- C. Shop fabricate Thru-wall, counterflashings, expansion joint metal and wind clips to greatest extent possible.
- D. Fabricate items to size and dimensions as indicated on the drawings. Limit single-piece lengths to twelve (12) feet for prefabricated pieces and ten (10) feet for shop fabricated pieces.
- E. Face of any fabricated vertical metal fascia or coping shall not exceed 8" without stiffener band or birds beak. If stiffener band or birds beak cannot be fabricate, contractor to use multiple pieces of metal to achieve overall distance without going over the 8" maximum per piece.
- F. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work sufficient to permanently prevent leakage, damage or deterioration of the work.
- G. Integrate flashing in a manner consistent with membrane waterproofing detailing. Form work to fit substrates.
- H. Make angle bends and folds for interlocking metal with full regard for expansion and contraction to avoid buckling or fullness in metal after installation.
- I. Fabricated items will have straight lines, sharp angles, smooth curves, and true levels. Avoid tool marks, buckling, and oil canning.
- J. Fold back edges on concealed side of exposed edge to form hem.

- K. Unless noted otherwise, lap joints minimum three (3) inch. Lap joints to have sealant installed as per details, to maintain watertight condition, inside and outside corners and elevation changes to be riveted and soldered.
- L. Seams:
 - 1. Wherever possible, fabricate non-moving seams in sheet metal with flat-lock seams and end joints.
 - 2. Pre-finished Galvanized Steel: Seal pre-finished metal seams with rivets and silicone sealant.
 - 3. Metal Other than Aluminum: Tin edges to be seamed, form seams, and solder.
- M. On Kynar 500 or Hylar 5000 pre-finished metal, surface sand metal flanges prior to applying any primers. Prime all metal in contact with bituminous material.
- N. Backpaint all concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.
- O. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used or would not be sufficiently waterproof or weatherproof, form expansion joints of intermeshing hooked flanges, not less than one (1) inch deep filled with mastic sealant concealed within joints.

2.6 FABRICATED ITEMS

- A. Metal Flashings:
 - 1. Through Wall Receiver Tray: Minimum 24 gauge stainless steel formed in maximum ten (10) foot lengths, through wall receivers shall not extend past the face of the exterior veneer more than $\frac{3}{4}$ ".
 - 2. Counterflashings: Minimum [24 gauge stainless steel] formed in maximum ten (10) foot lengths.
- B. Wind Clips: Minimum 24 gauge stainless steel (or match material of counterflashing), one (1) inch wide by length to engage counterflashing a minimum of 1/2 inch. To be installed at all wall flashings and at curb flashing lengths longer than 5 feet.
- C. Roof Penetrations:
 - 1. Umbrella Counterflashing: Two-piece construction of minimum 22 gauge stainless steel, fabricated in accordance with drawings or project requirements.
 - 2. Flashing Pans:
 - a. 24 gauge stainless steel.
 - b. Fabricate to provide installed minimum clear inside perimeter dimension of two (2) inches on each side of penetrating element.
 - c. Fabricate pans to at least six (6) inches above the finished roof membrane and with 1/4 inch hem at top edge and with four (4) inch flanges. Round all corners of flange.
 - d. Fabricate metal bonnets for all pans, NO EXCEPTIONS. Fabricate bonnets with metal compatible with metal to which bonnet is to be attached. On beams and other steel, weld in place bonnets fabricated from 1/4 inch steel plate. Draw band bonnets fabricated from 22 gauge stainless steel may be used on circular projections.
- D. Metal Edge / Fascia:
 - 1. Perma-Tite System 200 Fascia for thermoplastic roof systems: Decorative metal fascia with continuous formed rail.

- 1) Construction:
 - a) Fascia metal gauge
 - 1) 24 gauge galvanized steel.
 - b) Finish:
 - 1) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of colors.
 - c) Formed Rail: Shall be continuous 20 gauge galvanized steel at 12'-0" standard lengths with pre-punched slotted holes and 6" stainless steel springs at 4'-0" on center.
 - 2) Thermoplastic Version
 - a) Model:
 - 1) FA-80 (8.25" Face)
 - b) Performance:
 - 1) 20 year, 180 mph Wind Warranty.
 - 2) Tested per ANSI / SPRI ES-1 / FM 4435 Standard to a design pressure of 200 psf to comply with the International Building Code.
 - 3) FM tested to a minimum FM 1-180 rating
- E. Metal Coping
1. Perma-Tite Coping
 - 1) Construction:
 - a) Metal:
 - 1) 24 gauge galvanized steel.
 - b) Finish:
 - 1) Kynar-500 color as selected by the Architect from roof edge manufacturer's full range of colors.
 - 2) Coping Cap: Length of 12'-0", widths to 24" manufactured to job requirements. True radii may be built to template.
 - 3) Coping Vertical Face and Back Leg: 2 1/4" to 12 1/2" manufactured to job requirements.
 - 4) Concealed Splice Plates: 8" wide. Finish to match finish of coping cap with factory applied dual non-curing sealant strips.
 - 5) Anchor / Support Cleat: 20 gauge pre-punched galvanized cleat with stainless steel spring mechanically locked to cleat normally 12" wide at 4'-0" on center. Mechanically fastened as indicated and detailed.
 - 6) Fasteners: 1 1/2" stainless steel with driver.
 - 7) Performance:
 - a) 20 Year, 160 mph Wind Warranty
 - b) Tested per ANSI / SPRI ES-1 / FM4435 Standard to comply with the International Building Code.
 - c) Factory Mutual 1-90 approved for wind up lift protection.
 - d) Miami-Dade Approved (No. 13-0419.03 12/11/18) to comply with the "High Velocity Hurricane Zone of the Florida Building Code".
- F. Continuous Cleats (where applicable): Continuous strips, same material and profile, minimum one gauge heavier of item which cleats attach.
- G. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24 gauge stainless steel, or as shown or directed otherwise.
- H. Angle Termination Bar: Aluminum pressure bar 1/8 inch x one (1) inch.
- I. Vent Pipe Flashing: Four (4) pound lead. Provide proper size to fold down inside of pipe a minimum of one (1) inch.

- J. Gutters / Downspouts / Collector Heads: Seal-Tite Industrial Gutter System by manufacturer.
1. Minimum [24 gauge prefinished galvanized steel], formed in maximum twelve (12) foot lengths.
 2. Match dimension of existing. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
 3. Seal-Tite Industrial Gutter, including 2" Wide Gutter Straps 24" o.c., Wind Straps 6'-0" o.c., 1/8" Stainless Steel Pop Rivets, and #10 x 2" Stainless Steel Fasteners to be manufactured and supplied to suit profile and dimension of gutter and downspout by manufacturer.
 4. 24 gauge galvanized steel with membrane manufacturer's coating (specify)
 5. For Single Ply roofing systems: Drip Edge with Factory Applied Flashing PVC).
 6. End Caps, Downspout Outlets, Gutter and Downspout Straps, Support Brackets and joint fasteners to be manufactured to suit profile and dimension of gutter and downspout.
 7. Install all anchoring devices as outlined in manufacturer literature.
 8. Expansion Joints: Style 1 per manufacturer, locate every 50 linear feet.
 9. Gutter Straps and Supports: Minimum 3 per 12'-0" length, .100 inch thick downspout straps: Strap type, like metal, match color.
 10. Downspouts: Minimum [24 gauge prefinished galvanized steel] (match color).
 11. Downspout straps: Strap type, like metal, match color.
 12. Gutter Screen: .050" Aluminum with 1/4" dia. perforations
 13. Collect Heads: Minimum [24 gauge prefinished galvanized steel] (match color). As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrates are smooth and clean to extent required to perform sheet metal work.
- B. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set in place.
- C. Verify that reglets, nailers, cants, and blocking to receive sheet metal are in place and free of concrete and soil.
- D. Do not start work until conditions are satisfactory.

3.2 PREPARATION

- A. Field measure site conditions prior to fabrication work.
- B. Install starter and edge strips and cleats before starting installation.

3.3 INSTALLATION

- A. Install sheet metal with lines, arises, and angles sharp and true, and plane surfaces free from objectionable wave, warp, or buckle. Exposed edges of sheet metal shall be folded back to form 1/4 inch hem on concealed side from view. Finished work shall be free from water retention and leakage under all weather conditions. Prefabricated corners or transitions are required at changes in direction, elevation, or plane and at intersections. Locate field joints not less than 12 inches, nor more than three (3) feet from actual corner. Laps shall be one (1) inch, riveted and soldered at following locations:

1. Prefabricated corners;
 2. transitions;
 3. changes in direction, elevation, and plane; and
 4. at intersections.
- B. Anchor units of work securely in place to prevent damage or distortion from wind or buckling. Provide for thermal expansion of metal units; conceal fasteners wherever possible; and set units true to line and level as indicated. Install work with laps, joints, and seams which are permanently watertight and weatherproof.
- C. Install fabricated sheet metal items in accordance with manufacturer's installation instructions and recommendations and with SMACNA Architectural Sheet Metal Manual.
1. Ensure approved fasteners are used throughout the project.
 2. Ensure fasteners are installed in manufacturer pre-punched holes on rails, extrusions, clips and cleats.
 3. Ensure sufficient amount of waterblock is applied where appropriate to prevent leaking under rails/extrusions. **Contractor is responsible for cleaning stained brick and remedying for total length of workmanship warranty if waterblock is not installed appropriately.**
- D. Separations: Provide for separation of metal from dissimilar metal or corrosive substrates by coating concealed surfaces with zinc chromate, bituminous coating, or other permanent separation at locations of contact as recommended by manufacturer or fabricator. Do not use materials which are incompatible with roofing system.
- E. Cleat: At exposed edges of perimeter edge, fascias, cap flashings, and where required, attach cleat with appropriate fasteners supplied by roof edge manufacturer. Install cleat so fascia extends a minimum of 1 inch below top of exterior wall finish.
- F. Counterflashing:
1. Do not use surface mount counterflashing except as noted in drawings.
 2. Set in through wall with receiver and spring lock counterflashing, as detailed in drawings and to NRCA roofing manual, SMACNA standards.
 3. Coordinate installation of through-wall flashing with the masonry contractor.
 4. Seal through-wall in conjunction with masonry wall waterproofing.
 5. Install wind clips 30 inches o.c. at all counterflashing over five (5) feet in length.
- G. Pitch Pans, Metal Flanges (As Required):
1. Apply mastic under pitch pan or metal flashing flange at least 1/2 pound per linear foot.
 2. Prime all metal flanges with asphalt primer prior to flashing installation.
 3. Clean all projections enclosed in pitch pans in any manner suitable and coated with a rust inhibitive coating as approved by the Architect. Coating shall be allowed to dry prior to pitch pan fill.
 4. Fill base of pitch pans with grout or cementitious binder and allow to cure.
 5. Top Finish Fill: Self-leveling, one-part urethane; at least two (2) inches to top of pitch pan sides.
 6. Strip in pitch pan flanges with two strips of specified stripping plies set in hot bitumen extending three (3) inches from the outer edge of the flange to at least three (3) inches inward toward base of pitch pan. Provide finish stripping ply of SBS modified bitumen membrane in hot bitumen extending six (6) inches from the outer edge of the flange and butt to base of pitch pan.

- H. Sanitary Vent Stacks Modified Bitumen
 - 1. Prime top and bottom flanges of lead flashing sleeve. Set flange in uniform troweling of plastic roof cement. Prime top side of flange to receive strip-in membrane.
 - 2. Fold lead sleeve down inside of pipe a minimum of one (1) inch. Apply a continuous bead of sealant on inside of pipe prior to folding lead sleeve.

- I. Sanitary Vent Stacks: Thermoplastic Roof System
 - 1. Prepare substrate and fit pre-molded pipe boot.
 - 2. Heat weld pipe boot flange to prepared thermoplastic field membrane.
 - 3. Apply sealant as recommended by membrane manufacturer to inside of the top edge of the pipe boot. Install stainless steel pipe clamp ensuring no wrinkles or folds in the pipe boot membrane. Apply second bead of sealant at the top of the pipe boot.
 - 4. Install sheet metal umbrella flashing, pipe clamp and sealant above top of pipe boot.

- J. Gutters / Downspouts:
 - 1. Install gutters prior to edge metal and otherwise as detailed.
 - 2. Install downspouts plumb and level, attached to columns or wall with straps located at top and bottom of downspout and maximum ten (3) feet on center (note: 3 per 12' lengths supplied by manufacturer).
 - 3. Install splash pad or block under discharge port of downspouts (if non exist). Install splash pan over a protection (walkway) pad for downspouts located at roof level.

3.4 CLEANING AND PROTECTION

- A. Remove flux and residual acid immediately by neutralizing with baking soda and washing with clean water. Leave work clean of stains.
- B. Remove scraps and debris and leave work area clean.
- C. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes. Paint areas where finish is damaged on pre-finished metal by painting with a compatible paint in color to match undamaged finish.
- D. Prime soldered area of phosphatized metal after cleaning to prevent rusting.
- E. Paint metal flashings that have been soiled with bitumen with aluminized paint.
- F. Clean other work damaged or soiled by Work of this Section.
- G. Protect finished work from damage.

END OF SECTION 07 62 00

SECTION 07 65 00 - FLEXIBLE FLASHING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Provide flexible flashing where shown on drawings or required.

1.3 RELATED SECTIONS

- A. Section 03 30 00 – Cast-In-Place Concrete
- B. Section 04 20 00 – Unit Masonry
- C. Section 07 27 26 – Fluid Applied Air Barrier System
- D. Section 07 54 19 – Fully Adhered Thermoplastic Membrane Roofing System
- E. Section 07 54 23 – Fully Adhered Thermoplastic Membrane Roofing System

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Certification: Manufacturer's affidavit that materials used in Project contain no asbestos.
- C. Compatibility: Submit letter from primary Fluid Applied Air Barrier System Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from Manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Flexible flashing materials used shall be compatible with and not void any warranties of the air barrier system used. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 MATERIALS

- A. Flashing:
 - 1. Copper Laminated Flashing (Contractor's Option – in lieu of asphalt-free copper fabric flashing):
 - a. Flashing: A full sheet of copper weighing five (5) ounces per square foot coated or bonded on both sides with one (1) of the following:
 - 1) Modified asphalt compound coated.

- 2) Asphalt saturated, waterproof glass fiber laminated fabric.
- b. Approved Manufacturers:
 - 1) Advanced Building Products, Inc.
 - 2) Hohmann & Barnard, Inc.
 - 3) Sandell Manufacturing Company, Inc.
 - 4) York Manufacturing, Inc.
- c. Mastic: Manufacturer recommended asphalt troweled mastic for sealing copper laminated flashings
2. Asphalt-free Copper Fabric Flashing (Contractor's Option – in lieu of copper laminated flashing):
 - a. Glass fabric scrim bonded to a full sheet of copper for general through wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved sealant or seam tape.
 - b. Approved Product / Manufacturer: Multi-flash 500 as manufactured by York Manufacturing, Inc.; or Copper-Fabric NA or Copper-Fabric SA as manufactured by Hohmann & Barnard, Inc. (No substitutions).
3. Asphalt-free Stainless Steel Flexible Flashing (Contractor's Option – in lieu of copper laminated or asphalt-free copper fabric flashing):
 - a. Flexible minimum 2 mil thickness, Type 304 stainless steel sheet with factory applied adhesive with a release liner on one side for general through wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved sealant or seam tape.
 - b. Approved Product / Manufacturer: York 304 as manufactured by York Manufacturing, Inc.; or Mighty-Flash-SA as manufactured by Hohmann & Barnard, Inc. (No substitutions).
4. Membrane Flashing:
 - a. Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by Manufacturer.
 - b. Approved Products / Manufacturers:
 - 1) "CCW-705 TWF" manufactured by Carlisle Coatings and Waterproofing
 - 2) "Perm-A-Barrier" manufactured by W. R. Grace & Co.
 - 3) "Blueskin TWF" manufactured by Henry Co.
 - 4) "Air-Shield Through wall flashing" manufactured by W.R. Meadows, Inc.
 - 5) "TW-Thru Wall Flashing" manufactured by Tamko Waterproofing.
 - 6) AquaFlash 500" manufactured by Fiberweb.
5. Substrate Primer: Provide as instructed by Membrane Manufacturer.
6. Termination Bar: 14 ga. minimum thick by 1" minimum wide stainless steel, with pre-punched holes and ¼" minimum shouldered top flange. Provide with self-tapping screws.
7. Weathering Flange at Door / Window Openings: Provide a 20 gauge (0.040") stainless steel or .040 aluminum 2"x3" weathering flange at head, jamb and under sill pan of storefront window and hollow metal door systems. Screw attach into wood blockings or substrate walls and strip into air barrier system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Flashing:
1. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.
 2. Application Guidelines - Install flashing at the following locations:
 - a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge / exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck / exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.
 - b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill / weep conditions, exterior door and window head / weep conditions, intermediate and / or shelf angles, masonry wall cap flashing and masonry wall base flashing.
 3. Apply substrate primer as instructed by membrane manufacturer to suit condition.
 4. Provide drip edge flashing at weep conditions with membrane flashing. Cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind with outside edge of brick over top of drip edge flashing to alleviate exposure to UV degradation and deterioration of asphalt membrane.
 5. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.
 6. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.
 7. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar or in a full bed of mastic and topped with a fresh full bed of mortar. The flashing shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10) inches and secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.
 8. Thru-Wall Flashing: Shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.
 9. Lintel: Premolded or field molded end dams must be provided at each end of all lintels.

10. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.
 11. Heads, Jambs and Sills: Flashing for heads and sills shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded, NOT CUT. Jambs are to be turned into the buildings to complete seal perimeter of window or door. Install weepholes.
 12. Windows: wrap all heads, sills and jambs into opening with flexible flashings.
 13. Wood blockings: Flexible flashings are to cover wood blockings in their entirety.
 14. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
 15. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut $\frac{1}{4}$ " to $\frac{1}{2}$ " behind the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
 16. Lengths: Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
 17. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
 18. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
 19. Reglet Termination: Insert wedge into place and seal carefully with adhesive.
 20. Termination Bar: Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
 21. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full $\frac{1}{8}$ inch protective coating or mastic on all flashing faces.
 22. Lintels: Provide pre-molded end dams at all lintel ends.
- B. Bed Joints: Coordinate work with Division 4, Masonry. Install thru-wall flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back $\frac{3}{4}$ inch from face of masonry.

3.2 APPLICATION

- A. Protect membrane from overexposure to direct sunlight.
- B. Follow manufacturer's recommendations for installation.
- C. Adjacent Work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.

END OF SECTION 07 65 00

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 INSTALLATION RESPONSIBILITY

- A. In addition to the items normally a part of this Section, coordinate the installation of roof accessory curbs and pipe flashings and equipment supports that may be specified elsewhere.
- B. Coordinate the Work specified herein with the following Work:
 - 1. Roofing
 - 2. Roofing sheet metal
 - 3. Mechanical equipment
 - 4. Plumbing
 - 5. Electrical

1.3 REFERENCES

- A. Federal Specifications (FS)
 - 1. TT-S-00227E
- B. National Roofing Contractors Association (NRCA)
- C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
 - 1. Architectural Sheet Metal Manual

1.4 SUBMITTALS

- A. Product Data: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Shop Drawings: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.
- C. Contractor to provide proof of membrane material compatibility for roof bracing and supports.(Refer to section 2.6)

1.5 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 13 – Project Coordination.

1.6 WARRANTY

- A. Warranty the Work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 - 1. Noticeable deterioration of finish

2. Water infiltration into the building or within the construction.
- C. Rooftop supports – 5-year limited warranty.
- D. Roof bracing – 20-year limited warranty included in roofing warranty.
 1. Water infiltration into the building or within the construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on products of named manufacturers. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 1 requirements regarding substitutions to be considered.

2.2 PREFABRICATED ROOF CURBS

- A. Frames:
 1. Material: ASTM A 653 G90 hot-dipped galvanized steel.
 - a. Minimum 18 gauge, and as engineered by manufacturer.
 - b. Minimum 18 gauge for curbs supporting HVAC units
 - c. Minimum 20 gauge for expansion joint curbs.
 2. Corners: Mitered and welded (welds are micro sealed and prime painted after fabrication). Bolted connections not accepted.
 3. Base Plates: Integral to frame and welded.
 4. Internally reinforced with galvanized 1 inch by 1 inch by 12-gauge angles for curbs exceeding 3-foot length. Reinforce internal bulkhead at equipment curbs to support lateral loads.
 5. Wood Nailers: Factory installed; pressure treated. Size and width as suitable for support of items installed on curbs.
- B. Insulation: Factory installed 1-1/2 inch thick three-pound density fiberglass insulation.
- C. Curb Height: Minimum 8 inch above finished roof.
 1. Construct curbs to match roof slope with plumb and level top surface for mounting mechanical equipment.
- D. Gasketing: 1/4 inch thick, one (1) inch wide at roof top units.
- E. Counterflashing: 24-gauge stainless steel
- F. Counterflashing Cap: Stainless steel.
- G. Cants:
 1. Non-canted curb style installs either under or on top of metal decks with insulation.
 2. Cants shall be provided under Section 07 52 19 – Roofing
- H. All insulated roof curbs shall be structural and shall include calculations signed and sealed by a registered Structural Engineer. Refer to installation drawings for any additional structural requirements. If curbs do not span a minimum of two bar joists, only two angles will be required. Coordination mechanical equipment weight loading on the roof with Structural Engineer.

- I. Approved Manufacturers:
 - 1. Custom Curb, Inc.
 - 2. Roof Products, Inc.

2.3 PIPE SUPPORTS (Contractor built supports are not allowed)

- A. Gas Pipe Supports:
 - 1. Provide pipe roller type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10" x 16" x 3"; 5.5 lbs. each) and stainless-steel rods, washers, and nuts; Basis of design, PHP Systems / Design Model PP10-R with roller for gas pipe 3" O.D. and smaller.
 - 2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12" x 12" x 3"; 3 lbs. each or 18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for gas pipe larger than 3" O.D.
 - 3. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- B. Electrical Conduit / Condensate Pipe Supports:
 - 1. Provide channel / strut type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (10" x 16" x 3"; 5.5 lbs. each) and stainless-steel channel, rods, washers, and nuts; Basis of design, PHP Systems / Design Model PP10-C with channel for condensate pipe or conduit 3" O.D. and smaller.
 - 2. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (12" x 12" x 3"; 3 lbs. each or 18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 with hanger for condensate pipe or conduit larger than 3" O.D. Contractor to provide channel clamp at each support. Provide dissimilar metal protection as required.
 - 3. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- C. Chilled Water Pipe Supports:
 - 1. Provide hanger type support with bases of high density / high impact injection molded polypropylene with UV inhibitors (18" x 18" x 3"; 7 lbs. each or 18" round; 10.5 lbs. each) and stainless steel rods, washers and nuts; Basis of design, PHP Systems / Design Model PS-1-2 or Model PS-2-2 or Model PSE Custom as required with hanger(s) for chilled water pipe of any diameter.
 - 2. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- D. Crossover / Steps Pipe Supports:
 - 1. Provide channel / strut type support with bases of high density / high impact injection molded polypropylene with UV inhibitors and stainless-steel channel, rods, washers, and nuts; Basis of design, PHP Crossover.
 - 2. Acceptable Manufacturers: Miro Industries Inc.; MAPA Products; Advanced Support Products, nVent Caddy or Architect approved equal.
- E. Installation:
 - 1. Provide pipe supports at no greater than 8'-0" o.c. or as otherwise indicated in Manufacturer's Shop Drawings.

2. Provide pipe supports spaced so deflection of piping does not exceed 1/240 of span. If deflection exceeds 1/240 of span, decrease support spacing to 6'-0" o.c.
3. Provide complete and adequate support of all piping, ducts, and conduit.
4. Provide protective isolation pads adhered to the roof system below each pipe support using Roof System Manufacturer's approved adhesive.
5. Provide each pipe support adhered to the protective isolation pads using Roof System Manufacturer's approved adhesive.

2.4 ROOF TO ROOF EXPANSION JOINT

- A. Stainless Steel expansion joint covers on new wood curbs, as detailed on drawings and outlined the NRCA and SMACNA manual.

2.5 MISCELLANEOUS ROOF BRACING AND SUPPORT SYSTEMS

- A. Provide U-Anchors made of 304 stainless steel with 3/8" bolt and galvalume plate. Utilize same membrane as roofing manufacturer to be inclusive in 20 YEAR NDL warranty
- B. As manufactured by Anchor Products Model U-anchor 2000 Series as required for condition or nVent Caddy Pyramid Anchor system

2.6 ROOF PENETRATION HOUSING

- A. Provide rain-proof our-piece configuration consisting of a removable vandal resistant lid, middle housing, insulation extension (ICE) and wide flanged curb that is light weight and watertight. To be used with our exclusive two-piece aluminum and / or stainless-steel flanged Exit Seal with SilX14TM gasket. Provide 20 Year insured warranty.
- B. As manufactured by Roof Penetration Housing Model AWI Series Vault as required for condition or Architect approved equal.

2.7 ROOF DRAIN / DOWNSPOUT WALL NOZZLE

- A. Downspout Wall Nozzle at Concealed Roof Drain Leader / Discharge: Josam 25010 Series cast bronze Downspout Nozzle with loose flange and inlet threaded connection, or Architect approved equal. Diameter appropriate to downspout size.

2.8 FALL ARREST ROOF ANCHORS

- A. Fixed Roof Anchor: Provide fixed eye or stanchion type for continuous travel. Provide for structural anchorage as required for roof framing condition. Provide integral energy absorbing components. Provide with Type 304 stainless steel forged eye, anchor posts, intermediate / corner / end stanchions, and connection devices. Provide for dissimilar metal protection.
 1. Acceptable Manufacturers: Rooftop Anchor, Inc., "Horizontal Lifeline Systems;" FixFastUSA, "Travel 8 Static Line System – Top Mount SL200"; Thaler Metal
- B. Horizontal Wire Rope: Provide minimum breaking strength of a terminated wire rope to be at least twice the MAL, but not less than 6,500 lbf. The minimum rope diameter shall be 5/16". Wire rope lines shall comply with CSA G4.

2.9 DOUBLE DOOR ACOUSTIC RATED SMOKE VENTS

1. Type and Size: Acoustical Smoke Vents, AcousticMAX SV, rated per ASTM E 90 and OITC rated per ASTM 1332.
 - a. Performance:
 - 1) Certification: Smoke vent to have official UL label for testing to UL 793 Smoke and Heat Vents and FM 4430 Approved.
 - 2) STC Rating: STC 50 - OITC 47, model BSVZ Rated per ASTM E 90 and OITC rated per ASTM E 1332.
 - 3) Loads: 40-lbf/sq. ft. live load with a maximum deflection of 1/150th of the span; 90 lbf/sq. wind uplift.
 - 4) When release is actuated, lid shall open against 10-lbf/sq. ft snow or wind load and lock in position.
 - b. Door Options:
 - 1) Double Door: 72 by 72 inches.
 - c. Hatch Material:
 - 1) Cover: STC 50 - OITC 47 0.1046-inch galvanized steel cover and liner.
 - 2) Curb and Cover Insulation: STC 50 - OITC 47, 4-inch Mineral Wool insulation with sound mat contained within 4-1/4-inch-thick covers, providing total thermal resistance of R-16.8.
 - 3) Curb: STC 50 - OITC 47 0.1046-inch galvanized steel curb. 12-inch-high double wall curb with EZ tab counterflashing and 5-1/2-inch mounting flange with 1/2-inch diameter holes.
 - d. Finish:
 - 1) Cover Exterior: ANSI 70 Reflectance White powder coat steel.
 - 2) Cover Interior: Black powder coat finish.
 - 3) Curb: Black powder coat finish.
 - e. Latch:
 - 1) Latch released automatically by UL 33 listed fusible melt-out link at temperature of 280 deg F (138 deg C).

2.10 PLUMBING PEDESTAL HYDRANT

- A. Provide freeze-proof pedestal hose station / hydrant with stainless steel shroud, welded stainless steel flange, black powder coated cast aluminum dome handle, mail hose fitting and vacuum breaker. Provide powder coated under-deck support flange with hardware. Provide for dissimilar metal protection.

2.11 ELECTRICAL PEDESTAL DISCONNECT / OUTLET

- A. Provide rain-proof pedestal disconnect with stainless steel square tubing and welded stainless steel flange. Provide powder coated under-deck support flange with hardware. Provide for dissimilar metal protection.
- B. As manufactured by MAPA Products Model MPD Pedestal Disconnect as required for condition or Architect approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof accessories in accordance with manufacturer's printed instructions and approved shop drawings. Installation of Portable Pipe Hangers shall not exceed six (6) feet on center.
- B. Coordinate with roofing operation for watertight integrity.
- C. Finished installation shall be water and airtight. Install sealant conforming to FS TT-S-00227E, Type II, Class A.

END OF SECTION 07 72 00

SECTION 07 72 33 - ROOF SCUTTLE (HATCHES)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED WORK

- A. Section 03 32 16- Lightweight Insulating Concrete Deck System
- B. Section 05 31 00 - Metal Deck
- C. Section 05 50 00 - Miscellaneous Metals
- D. Section 06 10 00 - Rough Carpentry
- E. Section 07 52 19 – Modified Bitumen Membrane Roofing System
- F. Section 07 54 23 – Fully Adhered Thermoplastic Membrane Roofing System

1.3 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a watertight installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 SUBMITTALS

- A. Product Data: Submit schedules, charts, literature and illustrations to indicate the performance, fabrication procedures, product variations, and accessories.
- B. Shop Drawings: Include materials, opening sizes, fabrication details, hardware, attachments, related and adjacent work, and finishes.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Miami-Dade County, FL Approved NOA
 - a. TAS 201 Impact test
 - b. TAS 202 Uniform Static Air Pressure
 - c. TAS 203 Cyclic Wind Pressure Loading
 - 2. OSHA 29 CFR 1910.23 Guarding floor and wall openings and holes
 - 3. OSHA 29 CFR 1926.502 Fall protection systems criteria
 - 4. International Building Code (IBC) Section 1013.6 Roof Access
 - 5. International Building Code (IBC) Section 1009.11 Means of Egress, Stairways, Stairway to Roof
 - 6. International Building Code for venting requirements
 - 7. IBC Section 410 for Stages and Platforms
 - 8. IBC Section 910 for Factory and Storage occupancies

9. IBC Section 1207 Sound Transmission
10. Underwriters Laboratories Inc, UL 793 Listed for Heat and Smoke Vents
11. FM Global, Factory Mutual, FM 4430 Heat and Smoke Vents for Roofs
12. Reference NFPA 204 for general maintenance of Heat and Smoke vents
13. ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site ready use.
- B. Exercise proper care in handling of Work so as not to disrupt finished surfaces.
- C. Store materials under cover in a dry and clean location off the ground.

1.7 WARRANTY

- A. Warrant the work specified herein for five (5) years, against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include, but not be limited to, the following:
 1. Faulty, improper or inadequate attachment or installation.
 2. Difficult or noisy operation.
 3. Noticeable deterioration of finish.
 4. Leakage of water into the building or within the construction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis of Design Product: Subject to compliance with requirements: The Bilco Company.
- B. Manufacturers listed below whose products are equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of five (5) years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
 1. Acudor Products Inc.
 2. Babcock-Davis Hatchways, Inc.
 3. Dur-Red Products
 4. J. L. Industries, Inc.
 5. Karp Associates, Inc.
 6. Nystrom Building Products

2.2 ROOF SCUTTLES (HATCHES)

- A. Size: 2'-6" x 3'-0 unless shown otherwise.
- B. Finish: Mill Finish Aluminum White Powder Coat Aluminum.
- C. Thermally Broken Cover: Shall be 11 gauge aluminum with 3" concealed polyisocyanurate insulation, 5" beaded, overlapping flange, fully welded at corners, and internally reinforced for 40 psf live load., fully covered and protected by an aluminum liner. No water standing on top of the cover will be permitted.

- D. Thermally Broken Curb: Shall be 12 inches in height above finished roof surface and constructed of 11 gauge aluminum. It shall be formed with a 5-1/2 inch flange with holes provided for securing to the roof deck. Curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, full welded at the corners for weathertightness. Capflashing shall be equipped with the Bilclip™ flashing system, including stamped tabs and Pak-Rope. Insulation on the exterior of the curb shall be rigid fiber board three (3) inches in thickness.
- E. Thermally Broken Scuttle (Hatch): Shall be completely assembled with heavy pintle hinges, positive snap latch with turn handles, padlock hasps inside and outside, and a mechanically retained thermoplastic rubber gasket. Compression spring operators enclosed in telescopic tubes shall be provided for smooth, easy and controlled door operation throughout the entire arc of opening and closing. Operation shall not be affected by temperature. Cover shall be equipped with an automatic hold-open arm complete with red vinyl grip handle to permit easy release and one-hand control of the cover to its closed and latched position. All hardware shall be stainless steel. Gasket shall be extruded EPDM adhesive back seal and continuous around cover.
- F. Approved Model / Manufacturer: Type No. "S-50TB" Roof Scuttles (Hatches) for ladder access, or Architect approved equal.
- G. Roof Access Ladder: As specified in Section 05 50 00, Miscellaneous Metals. Ladder shall be oriented and mounted along the short dimension of the hatch.
- H. Fall Protection Safety Rail: 30"x36" Model SP 3036 [36"x36" Model SP 3036] by **SafePro L.C.** Guardrail height shall be 42" above finished roof surface. Color shall be powder coated safety yellow.
- I. Folding Fall Protection Safety Rail: Aluminum guardrail system [30"x36"] [36"x36"] Model by Precision Ladders LLC. Guardrail height shall be 42" above finished roof surface. Color shall be powder coated safety yellow.
- J. Telescoping Ladder Safety Post: Model ER-1 Extend-A-Rail Ladders Safety Post as manufactured by Precision Ladders LLC. 1.62" OD Schedule 40 anodized aluminum pipe post and 16"x4"x1/4" aluminum mounting plate. Provide with locking slot and knob. All mounting hardware shall be Type 316 stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate installation of sealant and roofing cement with Work of this Section to ensure water tightness.
- B. Coordinate installation of components of this Section with installation of roof deck, roof structure, roofing membrane, and base flashing.
- C. Roof hatches and heat / smoke vents shall be welded to structural steel frame of building.
- D. Install hatches and heat / smoke vents in accordance with details on drawings, approved shop drawings, and manufacturer's instructions.
- E. Set units plumb, level, and true to line without warp or rack. Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.

- F. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a watertight and airtight seal.

3.2 FIELD QUALITY CONTROL

- A. Smoke Vent Testing: Test for proper operation after installation by one or all of the operational methods.
- B. Melting fusible link for inside at smoke vent level recommend using handheld propane tank torch. Replace fusible link, then close vents from the exterior at the roof top level.
- C. Pull internal and / or external manual pull handles and then close vents from the exterior at the roof top level.
- D. Do not paint the internal mechanisms, especially moving parts such as spring, dampers, rotary latches and especially the fusible links. Painting any of these components may damage the vents and will void the warranty.

3.3 ADJUSTING

- A. Adjust movable parts for smooth operation.
- B. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation

3.4 CLEANING

- A. Clean exposed surfaces per manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 07 72 33

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.
- D. FM 4991 - Approval Standard of Firestop Contractors; 2013.
- E. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

1.4 ALLOWANCES

- A. Penetration firestopping Work is part of an allowance.

1.5 UNIT PRICES

- A. Work of this Section is affected by unit prices.

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.7 SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.
- C. Qualification Data: For Installer.
- D. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.8 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to GlobalFM 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its

"Qualified Firestop Contractor Program Requirements."

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.11 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

1.12 WARRANTY

- A. Written warranty signed by manufacturer, installer, and Contractor in which manufacturer agree to repair or replace firestopping materials that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 - 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 - 1. Permanent forming/damming/backing materials.
 - 2. Substrate primers.
 - 3. Collars.
 - 4. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.

3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION

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SECTION 07 84 43 - JOINT FIRESTOPPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints at exterior curtain-wall/floor intersections.
 - 3. Joints in smoke barriers.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
- C. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2023b.
- D. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020a.
- E. FM 4991 - Approval Standard of Firestop Contractors; 2013.
- F. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Qualification Data: For Installer.
- D. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 'sFM 4991, "Standard for the Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
 - 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E2307.
 - 1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
 - 1. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
- F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION

SECTION 07 92 00 - JOINT SEALANTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Control and expansion joints on exposed surfaces.
 - 2. Perimeter joints between wall surfaces and frames of doors and openings.
 - 3. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - 4. Joints indicated or as necessary.
 - 5. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

- A. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.
- B. ASTM C834 - Standard Specification for Latex Sealants; 2017.
- C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2018.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- E. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2018.
- H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
- I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
- J. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018.
- K. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- L. ASTM E2129 - Standard Practice for Data Collection for Sustainability Assessment of Building Products; Current.

1.4 SUBMITTALS

- A. Product Data: Technical data for each joint sealant product. Submit written certification from manufacturers of sealants attesting products are suitable for use indicated, verified through in house testing laboratory.
 - 1. Written certification from manufacturers of joint sealants attesting that products comply with specification requirements and suitable for use indicated verified through manufacturers testing laboratory within the past 36 months or since most recent reformulation, whichever is most recent.
 - a. Complete instructions for handling, storage, mixing, priming, installation, curing and protection of each type of sealant.
 - b. Manufacturer's letter, clearly indicating proposed lot numbers of each sealant supplied and expiration date sequence.
 - c. Instructions for handling, storage, mixing, priming, installation, curing, and protection of each type of sealant.

2. VOC Data: Submit manufacturer's product data for sealants. Indicate VOC limits of the product. Submit MSDS highlighting VOC limits.
 3. Submit environmental data in accordance with Table 1 of ASTM E2129 for products provided under work of this Section.
- B. Certificates and Reports:
1. Product Certificates: Manufacturer's product certificate for each kind of joint sealant and accessory.
 2. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
 3. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
 4. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - a. Materials forming joint substrates and sealant backings have been tested for compatibility and adhesion with sealants.
 - b. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
 5. Preconstruction Field Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified.
 6. Field Adhesion Test Reports: For each sealant application tested.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Firm having minimum 5 years documented experience and specializing in the installation of sealants.
1. Exposed sealant work (sealants used for air and weatherseals external to curtain wall systems at perimeter, metal panel to panel joints) shall be performed by a single (i.e. one) firm specializing in the installation of sealants who has successfully produced work comparable to project.
 2. Concealed sealant work (sealants which are internal to metal framed curtain wall systems, skylights, and providing an air seal) shall be the responsibility of the subcontractor providing erection of the respective system.
- B. Source Limitations: Obtain each type of joint sealant from a single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
 2. Test according to SWRI Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion in peel, and indentation hardness.
- D. Environmental Requirements:
1. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials.
 - a. VOC Content of Interior Sealants: Refer to 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions for VOC limits of sealants installed within the building.
 - b. Sealants containing aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not permitted.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer written instructions to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other

causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees F (4.4 degrees C).
 - 2. When joint substrates are wet. Should joints or backing materials become wet, remove and replace backing material with new.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

- A. Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealant work which has failed to provide a weathertight system within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- B. Warranties: Written warranties (weatherseal and stain resistance), signed by sealant manufacturer agreeing to furnish joint sealants to repair or replace those that fail to provide airtight and watertight joints, or fail in adhesion, cohesion, abrasion resistance, stain resistance, weather resistance, durability, or appear to deteriorate in manner not specified in the manufacturer's data as an inherent quality of the material within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion, 20 years for silicone sealants.
- C. Warranties specified exclude deterioration or failure of sealants from:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backings, and related materials compatible with one another and with joint substrates, air barrier system, and masonry under conditions of service and application, as stated by sealant manufacturer's published data, and as substantiated by the manufacturer for each application through testing.
- B. Liquid Applied Sealants: Comply with ASTM C920 and requirements indicated for each liquid applied sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain Test Response Characteristics: For sealants in contact with porous substrates, provide non-staining products that have undergone testing according to ASTM C1248 and do not stain porous joint substrates.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Colors: For fully concealed joints, provide standard color of sealant that has the best overall performance characteristics for the application shown. For exposed joints, match adjacent

surface. For exposed joints, submit color samples to architect for approval, from manufacturer's full line of standard colors.

- F. Manufacturer's Representative: Use sealant produced by manufacturer who agrees to send a qualified technical representative to site upon request for the purpose of rendering advice concerning the recommended installation of manufacturer's materials.
- G. Sealants: Self leveling compounds for horizontal joints in pavements and non-sag compounds elsewhere except as shown or specified.
- H. Silicone Sealant: ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
 - 1. Use: Precast Concrete Joints between metals, glass, and plastics (Two part silicone sealants).
 - 2. Properties: Performance: Non-staining, non-bleeding, and non-streaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion and Peel.
 - 3. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
 - 4. Product and Manufacturer: Dow Corning; 756 Silicone Building Sealant - HP with Additive.
- I. Silicone Sealant: ASTM C920, Type S, Grade NS, Class 50, use NT.
 - 1. Use: Precast Concrete Joints between metals, glass, and plastics (Single component sealants).
 - 2. Properties: Performance: Non-staining, non-bleeding, and non-streaking to sealed and adjacent substrates.
 - 3. Cure System and Oil Content: Neutral Cure System specifically manufactured with controlled oil content to eliminate oil migration into sealed substrates and residue rundown over and onto adjacent substrates.
 - 4. Product and Manufacturer:
 - a. BASF Building Systems; Omniseal 50.
 - b. Dow Corning Corporation; 756 SMS, 791, 795, 995 as applicable.
 - c. GE Advanced Materials, Silicones; SilGlaze II SCS2800, SilPruf NB SCS9000, SilPruf SCS2000, or UltraPruf II SCS2900 as applicable.
 - d. Sika Corporation, Construction Products Division; SikaSil-C995.
- J. Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 25; use NT, M, A and O.
 - 1. Use: Typical Wall and Floor Joints (Two part polyurethane sealants).
 - 2. Properties: Performance: Non-staining, non-bleeding, non-streaking to sealed and adjacent substrates.
 - 3. Products and Manufacturers:
 - a. BASF Building Systems; Sonolastic NP-2.
 - b. Pecora Corporation; Dynatred.
 - c. Sika Corporation, Construction Products Division; Sikaflex 2c NS or Sikaflex 2c NS TG as applicable.
- K. Two Part Polyurethane Sealants: ASTM C920, Type M, Grade NS, Class 50; use NT, M, A and O.
 - 1. Use: Typical Wall and Floor Joints (Two Part Polyurethane Sealants).
 - 2. Properties: Performance: Non-staining, non-bleeding, and non-streaking to sealed and adjacent substrates. The minimum pli value after 7 day immersion shall not be less than 13 when tested in strict accordance with ASTM C794 Adhesion in Peel.
 - 3. Products and Manufacturers: One of the following:
 - a. Schnee-Morehead, Inc.; Permthane SM 7200.
 - b. Sika Corporation, Inc.; Sikaflex - 2c NS TG.
 - c. BASF Construction Chemicals; NP 2.

- L. Mildew Resistant Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT, Substrate uses G, A, and O; and containing fungicide for mildew resistance; acid curing.
 - 1. Use: Joints at toilet fixtures, toilet room countertops and vanities, wet areas, and janitor closet mop receptor to wall transition.
 - 2. Products: Provide one of the following:
 - a. BASF Building Systems; Omniplus.
 - b. Dow Corning; 786 Mildew Resistant Silicone Sealant.
 - c. GE Silicones; Sanitary SCS 1700.
- M. Latex Sealant: Non-elastomeric, one part, non-sag, paintable latex sealant that is recommended for exposed applications on the interior. Complying with ASTM C834, Type OP (opaque sealants):
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; AC-20 + Silicone.
 - b. BASF; Sonolastic Sonolac.
- N. Acoustical Joint Sealant: Non-sag, paintable, non-staining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hilti, Inc.
 - b. Pecora Corporation; AC-20 FTR or AIS-919.
 - c. Specified Technologies, Inc.
 - d. USG Corporation; SHEETROCK Acoustical Sealant.
- O. Sealant Backing: Provide sealant backings that are non-staining; compatible with joint substrates, sealants, primers, and joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - 1. Cylindrical Sealant Backings: Preformed, compressible, resilient, non-staining, non-waxing, non-extruding backings of flexible plastic foam complying with ASTM C1330, and of type indicated below. Select shape and density of cylindrical sealant backings in consultation with the manufacturer for proper performance in specific condition of use in each case.
 - 2. Type C: Closed cell polyethylene foam material with surface skin, nonabsorbent to liquid water and gas, non-outgassing in unruptured state; one of the following:
 - a. HBR Closed Cell Backer Rod; Nomaco, Inc.
 - b. Sonolastic Closed-Cell Backer-Rod; BASF Construction Chemicals.
- P. Butyl Mastic Tape: High-tack, self-fusing butyl rubber mastic.
 - 1. Compatible with air barrier system.
 - 2. Locations: At masonry veneer anchors and where indicated on Drawings.
 - 3. Products: "Butyl Mastic Tape 2212" as manufactured by 3M or architect approved equal.
- Q. Miscellaneous Materials:
 - 1. Primer: Material recommended, as verified through compatibility and adhesion testing, by joint sealant manufacturer for the substrates indicated to be sealed.
 - 2. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.
 - 3. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surface adjacent to joints to which it is applied.
 - 4. Cork Joint Filler: Resilient and non-extruding ASTM D1752, Type II.
 - 5. Bond Breaker Tape: Polyethylene, TFE fluorocarbon, or plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler

materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants for compliance with requirements for joint configuration, installation tolerances, and conditions affecting sealant performance. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with the recommendations of joint sealant manufacturer and requirements:
 - 1. Remove foreign material from joint substrates interfering with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), existing joint sealants, oil, grease, water, surface dirt, and frost.
 - 2. Clean concrete, masonry, unglazed surfaces of tile and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil free compressed air.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean metal, glass, porcelain enamel, glazed surfaces of tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on prior testing and experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

- A. Silicone Glazing Sealants: Refer to Section 08 80 00 - Glazing.
- B. Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- C. Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants applicable to materials, applications, and conditions indicated.
- D. Sealant Backings: Install sealant backings to support sealants during application and at position necessary to produce cross sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings. Trim for tight fit around obstructions or elements penetrating the joint.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that become wet before sealant application and replace with dry sealant backings.
 - 4. Install bond breaker tape behind sealants where backings are not used between sealants and back of joints.
- E. Weeps and Vents: Install weeps and vents into joints at the same time sealants are being installed. Locate weeps and vents spaced recommended by sealant manufacturer and the

window and curtain wall fabricator and erector. Do not install weeps and vents at outside building corners. Do not install vents at horizontal joints immediately below shelf angles, sills, and through wall flashings.

- F. Sealants: Install sealants by proven techniques resulting in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at same time sealant backings are installed.
1. Apply sealants in depth in accordance with manufacturer's recommendations and recommended general proportions and limitations.
 2. Apply elastomeric sealants, in joints not subject to traffic or abrasion, to a depth equal to 50% of the joint width, but not less than 1/4 inch (6 mm) and not more than 1/2 inch (13 mm).
 3. Apply non-elastomeric sealants to a depth approximately equal to the joint width.
- G. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform, beads to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces. Tool exposed surfaces of sealants to the profile shown, or if none is shown, tool slightly concave.
1. Use masking tape to protect adjacent surfaces of recessed tooled joints.
 2. Provide a slight wash on horizontal joints where horizontal and vertical surfaces meet.
 3. Against rough surfaces or in joints of uneven widths avoid the appearance of excess sealant or compound by locating the compound or sealant well back into joint wherever possible.
- H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.
- I. Acoustical Sealant Installation: At sound rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer written recommendations.

3.4 FIELD QUALITY CONTROL

- A. Field Adhesion Testing: Field test exterior wall joint sealant adhesion to joint substrates:
1. Extent of Testing: Test completed and cured sealant joints:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
 2. Test Method: Test joint sealants according to Method A, Field Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer field adhesion hand pull test criteria.

4. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure original sealant surfaces are clean and new sealant contacts original sealant.
- B. Evaluation of Field Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 SITE ENVIRONMENTAL PROCEDURES

- A. Indoor Air Quality: Provide temporary ventilation during work. Coordinate interior application of sealants with interior finishes schedule.

3.6 CLEANING AND PROTECTION

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- B. Protect joint sealants during and after curing from contact with contaminating substances and from damage so sealants are without deterioration or damage at time of Substantial Completion. If, despite protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION

SECTION 07 95 13 - EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Expansion joint cover assemblies for floor, wall, ceiling, soffit, and _____ surfaces.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications: Custom fabricated metal expansion and control joint devices.
 - 2. Section 07 92 00 - Joint Sealants: Sealing expansion and control joints using gunnable and pourable sealants.
 - 3. Section 09 21 16 - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.
 - 4. Section 09 51 00 - Acoustical Ceilings: Expansion joint assemblies in suspended ceiling grids.

1.3 REFERENCE STANDARDS

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.
- C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction and anchorage locations.
- D. Samples: Submit two samples 6 inch (150 mm) long, illustrating profile, dimension, color, and finish selected.
- E. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Architectural Art Mfg, Inc: www.archart.com/#sle.
 - 2. Balco, Inc.: www.balcousa.com/#sle.
 - 3. Construction Specialties, Inc: www.c-sgroup.com/#sle.
 - 4. EMSEAL Joint Systems, Ltd: www.emseal.com/#sle.
 - 5. Inpro: www.inprocorp.com/#sle.
 - 6. MM Systems Corp: www.mmsystemscorp.com/#sle.
 - 7. Nystrom, Inc: www.nystrom.com/#sle.
 - 8. Pecora Corporation: www.pecora.com/#sle.

9. SITURA Inc: www.situra.com/#sle.
10. Watson Bowman Acme Corporation: www.watsonbowmanacme.com/#sle.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

- A. Interior Floor Joints Subject to Thermal Movement (EJC-1):
 1. Basis of Design Manufacturer(s) and Product(s):
 2. Color: Gray.
- B. Interior Wall/Ceiling Joints Subject to Thermal Movement (EJC-3):
 1. Basis of Design Manufacturer(s) and Product(s):
 - a. Inpro 101 Recessed Expansion Joint Mount.
 2. Color: Gray.
- C. Exterior Wall Joints Subject to Thermal Movement (EJC-9):
 1. Basis of Design Manufacturer(s) and Product(s):
 - a. Balco, Inc; Exterior Wall, Elastomeric Face Seal System (FCWW).
 - b. Construction Specialties, Inc; Exterior Wall Covers.
 - c. EMSEAL Joint Systems, Ltd; BG System.
 - d. SITURA Inc; RedLINE Waterproof Expansion Joint Systems.
- D. Exterior Wall Joints Subject to Seismic Movement (EJC-10):
 1. Basis of Design Manufacturer(s) and Product(s):
 - a. SITURA Inc; RedLINE Waterproof Expansion Joint Systems.
- E. Exterior Roof Bellows with Metal Flange Expansion Joint Covers (EJC-11):
 1. Basis of Design Manufacturer(s) and Product(s):
 - a. Balco, Inc; Roof Bellows, Aluminum Flanges (BRBA).
- F. Exterior Roof Expansion Joint Covers (EJC-12):
 1. Basis of Design Manufacturer(s) and Product(s):
 - a. Balco, Inc; Roof Metal Plate System, with Canted Curb (LPR).
 - b. SITURA Inc; RedLINE Waterproof Expansion Joint Systems.
- G. Below Grade, Blind-Side and Positive-Side, and Under-Slab Joints (EJC-16):
 1. Basis of Design Manufacturer(s) and Product(s):
 - a. EMSEAL Joint Systems, Ltd; BG System.
 - b. SITURA Inc; RedLINE Waterproof Expansion Joint Systems.

2.3 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
 1. Joint Dimensions and Configurations: As indicated on drawings.
 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 3. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
 4. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 5. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
- B. Floor Joint Covers: Coordinate with indicated floor coverings.
 1. If floor covering is not indicated, obtain instructions from Architect before proceeding.
 2. If style is not indicated, provide extruded aluminum frame both sides, resilient seals, and minimize exposed metal.
- C. Covers in Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.

2.4 MATERIALS

- A. Anchors and Fasteners: As recommended by cover manufacturer.
- B. Ferrous Metal Anchors: Galvanized where embedded in concrete or in contact with cementitious materials.
- C. Threaded Fasteners: Aluminum.
- D. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.
- B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

3.2 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Install expansion joints in accordance with TCA publication EJ171.
- C. Align work plumb and level, flush with adjacent surfaces.
- D. Rigidly anchor to substrate to prevent misalignment.

3.3 PROTECTION

- A. Do not permit traffic over unprotected floor joint surfaces.
- B. Provide strippable coating to protect finish surface.

END OF SECTION

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SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide items shown on the Drawings and specified, including, but not limited to the following:
 - 1. Standard steel doors for interior use.
 - 2. Acoustically-insulated steel doors for interior use.
 - 3. Thermally-insulated doors for interior or exterior use.
 - 4. Steel frames for doors, sidelites, transoms, and windows.
 - 5. Louvers in steel doors.
 - 6. Vision lites in steel doors.
 - 7. Sound rated steel doors.
 - 8. Thermally rated steel doors.
- B. Related Sections:
 - 1. Section 05 40 00 - Cold Formed Metal Framing.
 - 2. Section 07 92 00 - Joint Sealants.
 - 3. Section 08 80 00 - Glazing.
 - 4. Section 09 21 16 - Gypsum Board Assemblies.
 - 5. Section 09 24 00 - Cement Plastering.
 - 6. Section 09 90 00 - Painting and Coating.

1.3 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process; 2022a.
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- D. ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus; 2019.
- E. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- F. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- G. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- H. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- I. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's standard details and catalog data demonstrating compliance with specifications and referenced standards.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings:

1. Indicate complete schedule in detail for each steel door and frame using the same reference number for details and openings as those on the contract Drawings. If any door is not by the steel door manufacturer, only the door opening number should be shown along with the type of door (wood, plastic laminate faced, etc.):
 - a. Show details of construction, installation, connections, anchors, hardware reinforcement, hardware preparation, louvers, and floor and threshold clearances.
- C. Samples are required from non-Steel Door Institute members:
 1. 12-inch by 12-inch sample of a fire-rated and non-rated door, cut from corner of door, showing door construction.
 2. 12-inch by 12-inch sample of each type of door louver specified or required, showing louver construction.
 3. Six-inch (6") long sample of a fire-rated, non-rated frame, and each type of glass stop specified or required, showing corner and construction.
- D. Certificates: Manufacturer's certification that oversized openings are in compliance with specifications.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: If other than a manufacturer listed under Paragraph 2.1 is proposed for use on the Project, it shall be a company specializing in the manufacturer of steel doors and frames of the type specified for this Project with a minimum of five (5) years' experience.
- B. All steel doors and frames shall be by a single manufacturer, shop drawings to be submitted with manufacturer's insignia, which is being supplied.
- C. Furnish steel doors and frames to meet current ANSI/Steel Door Standards.
- D. ANSI A250.13 Testing and Rating of Sever Windstorm Resistant Components for Swing Door Assemblies.
- E. ASTM E330/E330M, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference.
- F. Comply with ASTM E283/E283M Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- G. Regulatory Requirements:
 1. Accessibility Requirements:
 - a. Comply with applicable requirements:
 - 1) Texas Accessibility Standards (TAS).
- H. Pre-Installation Conference: Refer to Section 01 31 00 - Project Management and Coordination.

1.6 WARRANTY

- A. Warrant the work specified herein for one (1) year against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship.
- B. Defects shall include, but not be limited to:
 1. Use of incorrect materials in opening.
 2. Incorrect labeled components installed within opening.
 3. Noisy, rough, or difficult operation.
 4. Failure to meet specified quality assurance requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in accordance with manufacturer's instructions, and as follows:
 1. In manufacturer's original, clearly labeled, undamaged containers or wrappers.
 2. Containers or wrappers shall list the name of the manufacturer and product.

- B. Deliver materials to allow for minimum storage time at the Project site. Coordinate delivery with the scheduled time of installation.
- C. Protect products from moisture, construction traffic, and damage:
 - 1. Store under cover in a clean, dry place, protected from weather and abuse.
 - 2. Store in a manner that will prevent rust or damage.
 - 3. Store doors in a vertical position, spaced with blocking to permit air circulation.
 - 4. Do not use non-vented plastic or canvas shelters.
 - 5. Should containers or wrappers become wet, remove immediately.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are acceptable for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Ceco Door, an ASSA ABLOY company: www.cecodoor.com/#sle.
 - 2. CURRIES, an ASSA ABLOY company: www.curries.com/#sle.
 - 3. Pioneer Industries, Inc., an ASSA ABLOY company.: .
 - 4. Republic Builders Products Company: www.pioneerindustries.com/#sle.
 - 5. Steelcraft Mfg. Co., an Allegion company: www.steelcraft.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 MATERIALS, GENERAL

- A. Exterior frames and interior frames where shown on Drawings or required in damp, moist, humid, and wet areas, i.e., toilets, locker rooms, showers, etc., to be manufactured of commercial quality, stretcher leveled flatness, cold rolled steel and galvanized to A-60 minimum coating weight standard per ASTM A653/A653M and ASTM A924/A924M, with coating weight of not less than 0.60 ounce per square foot (0.30 ounce per square foot per side).

2.3 FRAME FABRICATION

- A. Minimum Gauges:
 - 1. Interior:
 - a. Openings less than 4 feet wide: 16 gauge.
 - b. Openings 4 feet in width and greater: 14 gauge.
 - 2. Exterior: 14 gauge.
- B. Design and Construction:
 - 1. Frames shall be custom made, welded units with integral trim of sizes and shapes shown on approved shop drawings. Hinge jambs that butt adjacent 90-degree walls shall have at least four-inch (4") wide frame face to assure the door trim will not strike the wall prior to the door opening at least 90 degrees. Frame profile shall match wall thickness where practical, i.e., 4-3/4-inch at four-inch (4") CMU, 6-3/4-inch at six-inch (6") CMU, and 8-3/4-inch at eight-inch (8") CMU. At masonry wall openings, fabricate frames to suite masonry opening with two-inch (2") head member.
 - 2. Frames shall be strong and rigid, neat in appearance, square, true, and free of defects, warp, and buckle. Molded members shall be clean cut, straight, and of uniform profile throughout their length.
 - 3. Jamb depths, trim, profile, and backbends shall be as shown on approved shop drawings.
 - 4. Corner joints, including face and inside corners, shall have contact edges closed tight, with trim faces mitered and continuously welded, and stops butted. The use of gussets shall not be permitted. Face of frame shall be ground smooth. Knockdown (KD) frames

- are not permitted.
5. Minimum depth of stops shall be 5/8 inch, except at fire windows where minimum depth of stops shall be 3/4 inch.
 6. Frames for multiple openings shall have mullion and rail members that are closed tubular shapes having no visible seams or joints. Joints between faces of abutting members shall be securely welded and finished smooth. Mullions shall be key locked removable type. Keys shall be master keyed to Owner's Best system.
 7. High-Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inch and wider with mortise/butt type hinges only at top hinge location to deter against hinge reinforcement sag.
 8. Continuous Hinge Reinforcement: Provide welded continuous 12-gage strap for continuous hinges specified in hardware sets in Division 08 Openings.
 9. Provide countersunk flat or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops; provide security head screws at exterior locations.
 10. Provide A60 galvanized coating at frames in the following locations:
 - a. Locker rooms.
 11. Electrical Knock Out Boxes:
 - a. Factory weld 18-gage electrical knock out boxes to frame for electrical hardware preps; included but not limited to electric thru wire hinges, electrical raceways, door position switches, electric strikes, jamb mount card readers, and magnetic locks as noted in door hardware sets in Division 08 Openings:
 - 1) Electrical knock out boxes are required at door position switches, electric strikes, card readers, and middle hinge locations.
 - 2) Provide electrical knock out boxes with 3/4-inch knockouts.
 - 3) Conduit to be coordinated and installed in field from middle hinge box and strike box to door position box.
 - 4) Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 08 - Openings.
 - 5) Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.
 - 6) Provide field installed conduit per Division 28 - Electronic Safety & Security Section for standardized plug connectors to accommodate up to twelve (12) wires as required for electrified door hardware specified in hardware sets in Division 08 Openings. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
 12. Hardware reinforcements:
 - a. Frames shall be mortised, reinforced, drilled, and tapped at factory for fully template mortised hardware in accordance with approved hardware schedule and templates provided by Section 08 71 00 - Door Hardware. Where surface-mounted hardware is to be applied, frames shall have reinforcing plates only.
 - b. Minimum thickness of hardware reinforcing plates shall be as follows:
 - 1) Hinge and pivot reinforcements (1-1/4-inch x 10-inch minimum size): Seven (7) gauge.
 - 2) Strike Reinforcements: 12-gauge stiffeners.
 - 3) Flush Bolt Reinforcements: 12-gauge.
 - 4) Closer Reinforcements: 12-gauge.
 - 5) Reinforcements for surface-mounted hardware, hold-open arms, and surface panic devices: 12-gauge.
 13. Floor Anchors: Minimum 14-gauge, securely welded inside each jamb, with holes for floor anchorage.
 14. Jamb Anchors:

- a. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the T-strap type. Anchors shall be not less than 16-gauge steel. The number of anchors provided at each jamb shall be as follows:
 - 1) Frames up to seven-feet-six-inches (7'-6") in height: Three (3) anchors.
 - 2) Frames seven-feet-six-inches (7'-6") to eight feet (8') in height: Four (4) anchors.
 - 3) Frames over eight feet (8') in height: One (1) anchor for each two feet (2') or fraction thereof in height.
 - b. Frames for installation in wood or metal stud partitions shall be provided with steel anchors of suitable approved design, not less than 16-gauge thickness, securely welded inside each jamb as follows:
 - 1) Frames up to seven feet six inches (7'-6") in height: Four (4) anchors.
 - 2) Frames seven feet six inches (7'-6") to eight feet (8') in height: Five (5) anchors.
 - 3) Frames over eight feet (8') in height: Four (4) anchors plus one (1) additional for each two feet (2') or fraction thereof over eight feet (8').
 - c. Frames to be anchored to previously placed concrete, masonry, or structural steel shall be provided with anchors of suitable design as shown on approved shop drawings.
15. Dust Cover Boxes: Shall be of not less than 26-gauge steel and shall be provided at all mortised hardware items. Eight-inch (8") CMU walls with face brick shall have dual offset jamb anchors.
 16. Steel Spreader: Shall be provided on all frames, temporarily attached to bottoms of both jambs for bracing during shipping and handling.
 17. Loose glazing stops: Shall be of cold rolled steel, not less than 20 gauge, butted at corner joints and secured to the frame with countersunk cadmium or zinc-plated screws. Loose stops at exterior frames shall be placed on the interior side of the frames.
 18. At sound rated door openings and at masonry openings, coat inside of frame profile with corrosion resistant coating to minimum thickness of 1/16 inch.
- C. Frame Color: Field paint under Section 09 90 00 - Painting and Coating, color as indicated on Drawings.

2.4 DOOR FABRICATION

- A. Minimum Gauges:
 1. Doors: 0.047 inch or 18 gauge (16 gauge for high frequency doors).
 2. 16 gauge (14 gauge for windstorm rated doors).
- B. Design and Construction:
 1. Thickness shall be 1-3/4 inch, unless specifically noted or shown otherwise.
 2. Exterior doors: Provide doors with 22-gage steel z-channels placed at six inches (6") apart with foamed in place polyurethane core, with a thermal insulation calculated R factor of 11.01 per ASTM C518 Standards.
 3. Fabrication:
 - a. Doors shall be strong, rigid, and neat in appearance, free from warpage and buckle.
 - b. Corner bends shall be true, straight, and of minimum radius for gage of metal used.
 - c. Provide stiffeners with polystyrene core spaced maximum 6 inches on center and extending full height of door.
 - d. Fill interior with noncombustible fiberglass insulation. Use rock mineral wool board filler as required for labeled doors.
 - e. Faces shall be joined at vertical edges of door by a continuous weld extending full height of door. Welds shall be ground, filled, and dressed smooth to provide a smooth flush surface.
 - f. Top and bottom edges of doors shall be closed with a continuous recessed steel channel not less than 16 gauge, extending full width of door and spot weld to both faces. Exterior doors shall have an additional flush closing channel at top and bottom edges. Openings shall be provided in the bottom closure channel at top and bottom

- edges. Openings shall be provided in the bottom closure of exterior doors to permit the escape of entrapped moisture.
- g. Continuous Hinge Reinforcement: Provide welded continuous 12-gage strap for continuous hinges specified in hardware sets in Division 08: Openings.
 - h. Electrical Raceways: Provide raceways for standardized plug connectors to accommodate up to 12 wires as required for electrified door hardware specified in hardware sets in Division 08: Openings. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
 - i. Doors in wet or humid areas shall have a top cap and solid foam interior core to prevent internal moisture accumulation and galvannealed.
 - j. Edge profile shall be provided on both vertical edges of door as follows:
 - 1) Single-acting swing doors: Beveled 1/8 inch in two inches (2").
 - k. Hardware Reinforcements:
 - 1) Doors shall be mortised, reinforced, drilled, and tapped at factory for fully template hardware, in accordance with the approved hardware schedule and templates provided by Section 08 71 00: Door Hardware. Where surface-mounted hardware is to be applied, doors shall have reinforcing plates only.
 - 2) Minimum gauges for hardware reinforcing plates shall be as follows:
 - (a) Hinge and pivot reinforcements: Seven (7) gauge.
 - (b) Reinforcements for lock face, flush bolts, concealed holders, concealed or surface-mounted closers: 12 gauge.
4. Glass Moldings and Stops: Loose stops shall be not less than 20-gauge steel, with butt corner joints, secured to frame opening by countersunk screws. Snap-on attachments will not be acceptable.
5. Louvers: Shall be inverted "V" blade, sight-proof type, unless noted otherwise.
6. Edge Clearances:
 - a. Between door and frame at head and jambs: 1/8 inch.
 - b. At doorsills with no threshold: 5/8-inch to 3/4-inch above finished floor.
 - c. At doorsills with threshold: As required to suit threshold.
 - d. Between meeting edges of double doors: 1/8 inch.
- C. Finish:
 - 1. Shop paint steel (whether galvanized or ungalvanized) stops and accessories as follows:
 - a. Clean surfaces free of mill scale, rust, oil, grease, dirt, and other foreign matter.
 - b. Chemically treat surfaces and apply one (1) coat of an approved baked-on rust-inhibitive primer paint to provide a minimum 0.5 mil dry film thickness.
 - 2. Field painted under Section 09 90 00 - Painting and Coating.
- D. Sound Rated Door: STC of 32, measured in accordance with ASTM E413.
- E. Thermal Insulated Door: Total insulation R-Value of 44 measured in accordance with ASTM C1363, unless otherwise noted on Drawings.

PART 3 EXECUTION

3.1 COORDINATION

- A. Coordinate the work of this Section.
- B. Coordinate hardware installation with opening construction. Door hardware is specified in Section 08 71 00 - Door Hardware.
- C. Coordinate doors, frames, and windows with glazing specified in Section 08 80 00 - Glazing.
- D. Coordinate doors and frames with painting specified in Section 09 90 00 - Painting and Coating.

3.2 INSTALLATION

- A. Separate dissimilar metals. Protect against galvanic action.

B. Frames:

1. Anchorage and connections: Secure to adjacent construction. Where practical, interior door frames shall be flush with the pull side wall to minimize or eliminate the reveal and allow full 180-degree door swing.
2. Install frames in accordance with manufacturer's instructions and install labeled frames in accordance with NFPA 80.
3. Frame spreader bars: Leave intact until frames are set perfectly square and plumb and anchors are securely attached.
4. Remove hardware, with the exception of prime-coated items, tag box, and reinstall after finish paint work is completed. Do not remove or paint over labels on labeled frames.

C. Doors:

1. Install hardware in accordance with hardware manufacturer's templates and instructions.
2. Install doors in accordance with manufacturer's instructions and install labeled doors in accordance with NFPA 80.
3. Adjust operable parts for correct function.
4. Remove hardware, with the exception of prime-coated items, tag, box, and reinstall after finish paint Work is completed. Do not remove or paint over labels on labeled doors.

3.3 ADJUST AND CLEAN

- A. Adjust doors for proper operation, free from binding or other defects.
- B. Clean and restore soiled surfaces.
- C. Remove scraps and debris, and leave site in clean condition.

END OF SECTION

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SECTION 08 11 16 - ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry.
 - 2. Section 08 14 16 - Flush Wood Doors.
 - 3. Section 08 71 00 - Door Hardware.
 - 4. Section 08 80 00 - Glazing.
 - 5. Section 09 21 16 - Gypsum Board Assemblies.

1.3 REFERENCES STANDARDS

- A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's literature describing products to be provided.
- B. Shop Drawings:
 - 1. Submit shop drawings showing elevation of frames, profile, design construction details, methods of assembling sections, hardware locations, dimensions, anchorage and fastening methods, wall opening construction and finish requirements. Indicate location of each frame in Project.
 - a. Indicate location of each frame in Project.
 - b. Cross reference to Schedules.
- C. Samples:
 - 1. Submit four samples of frames showing selected finishes, corner joint, hinge reinforcement and anchors.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Engage experienced Installer who has completed installations of aluminum frames similar in design and extent to those required for project and whose work has resulted in construction with record of successful in-service performance.
- B. Manufacturer's Qualifications:
 - 1. Provide aluminum framing systems produced by firm experienced in manufacturing systems that are similar to those indicated for this project and that have record of successful in-service performance.
- C. Single Source Responsibility:
 - 1. Obtain aluminum framing systems from one source and from single manufacturer.
- D. Design Criteria:
 - 1. Drawings indicate the size, profile and dimensional requirements of aluminum frames required and are based on specific types and models indicated.

2. 60/90 minute rated frames shall be aluminum clad frames. Hollow metal not permitted.
- E. Regulatory Requirements:
1. Installed frame and door assembly shall conform to NFPA 80 for fire rated class indicated.
 2. Where doors are noted with an hourly fire resistance rating, provide door and frame assemblies labeled by Underwriter's Laboratory, or any other testing laboratory approved by the local code authorities, to meet the hourly fire rating noted. Assemblies shall meet applicable building code requirements for positive pressure.
 3. Where an aluminum metal frame is used as a glazed opening in an interior fire rated wall assembly, the frame shall be labeled to match the fire rating required for a door assembly in the fire rated wall, except in a 1 hour fire rated corridor wall assembly, the glazed frame shall be labeled to a 45 minute rating. In a 1 hour fire rated corridor wall assembly, where the door frame is integral with the glazed frame, the frame shall have a 45 minute rating.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Packing, Shipping, Handling and Unloading:
1. Deliver materials in original unopened packaging with labels intact.
 2. Handle frames in a manner to prevent damage to finishes.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
1. Avalon International Aluminum, LLC.
 2. Frameworks. Not desired.
 3. RACO.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 BASIS OF DESIGN

2.3 MATERIALS

- A. Aluminum Frames: Extruded aluminum
1. Standard alloys shall conform to requirements published in AA ASD-1 and ASTM B221; 6063 T5 alloy.
 2. Thickness: 0.062 inch minimum.
 3. Finish: Thermal-setting powder coating / Class II clear anodized.
 4. Flush 1-1/2 inch or 2 inch face casing, extended lip strike not permitted.
 5. Throats or frames to be nominal wall thickness plus an 1/8 inch.
- B. Fire Rated Frames:
1. Labeled frames shall be provided for those openings requiring a 20/45/60/90 minute fire protection rating as indicated on Drawings.
 2. Frames shall be constructed as tested and approved by Warnock Hersey Laboratories. Other nationally recognized testing agency having a periodical factory inspection service may be used subject to approval of authority having jurisdiction.
 3. Should any frame indicated to be fire rated not qualify for appropriate labeling because of its design, hardware, or any other reason, notify Architect before fabrication work on that frame is started.
- C. Doors: Manufacturer's standard glazed aluminum doors for manual-swing or sliding operation.
1. Door Construction: 1-3/4 inch overall thickness, with extruded aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that incorporate concealed tie bolts.

2. Door Design: Wide Stile; 5 inch nominal width.
 3. Glazing Stops and Gaskets: Snap-on, extruded aluminum stops and preformed gaskets.
- D. Glass and Glazing Materials: Refer to Section 08 80 00 - Glazing.
- E. Fasteners: Provide fasteners of aluminum, non-magnetic stainless steel, zinc plated steel, or other material warranted by the manufacturer to be non-corrosive and compatible with aluminum components, hardware, anchors and other components.
1. Reinforcement: Where fasteners screw-anchor into aluminum members less than 0.125 inches thick, reinforce interior with aluminum or non-magnetic stainless steel to receive screw threads, or provide standard non-corrosive pressed-in splined grommet nuts.
 2. Exposed Fasteners: Do not use exposed fasteners except for application of hardware. For application of hardware, use Phillips flat-head machine screws that match the finish of member or hardware being fastened.

2.4 FABRICATION

- A. Frames:
1. Frames shall be knock-down units consisting of separate header, strike and hinge jambs with snap-on casing, fabricated to sizes indicated on Drawings.
 2. Thickness of main frame members shall be increased to 0.130 inch minimum at frame and hinge anchorage.
 3. Frames shall be supplied with a notch at top of jamb and corner brackets to provide for correct alignment with header and add strength to joint.
 4. Stops shall be provided with a continuous nylon backed wool pile sound and light seal around perimeter.
 5. Finished work shall be strong and rigid, neat in appearance, square, true and free of defects, warp, or buckle. Members shall be clean cut, straight and of uniform profile throughout their lengths.
 6. Frames shall be pressure fit type that are installed after partition is in place. Frames shall be anchored at bottom of each jamb. Additional anchors shall be furnished per manufacturer's recommendations.
 7. Glazing frames shall be provided with snap-in type stops with manufacturer's standard neoprene gaskets. Glass installed adjacent to metal without intervening gasket shall not be allowed. Door jambs with integral glazing shall have reinforcement channel. Intermediate mullions shall maintain 1-1/2 inch profile.
 8. Continuity: Maintain accurate relation of planes and angles with hairline fit of contacting members.
 9. Uniformity of Metal Finish: Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample per submittal.
 10. Fasteners: Exposed fasteners not permitted.

2.5 FINISHES

- A. Shop Applied Finish:
1. Remove die markings prior to finishing operations. Perform this work in addition to finish specified. Scratches, abrasions, dents and similar defects are not acceptable.
 2. Color: Powder coating, color to be selected by Architect.
- B. Thermal-Setting Powder Coatings:
1. Aluminum frames shall have shop applied finish with a thermal-setting powder coating applied in compliance with AAMA 605.2. Finish system shall have a minimum dry film thickness of 1.8 mil applied over a seven stage aluminum pre-treatment.
 2. Colors: Manufacturer's standard color or custom color to match control sample provided by Architect.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Frames:
 - 1. Prior to installation rough openings shall be checked and corrected for size, squareness, alignment and plumbness.
 - 2. Slip header and jambs into rough opening, allowing header to rest on jambs. Align to scheduled opening width and height, achieving equal wall capture at both jambs.
 - 3. Check level of header and squareness and plumb of jambs. Measure width at each hinge location.
 - 4. Attach flat corner angles at faces of head. Anchor jambs and header in legs of frame at top and bottom of jambs and at approximately 15 inches on center.
 - 5. Install mitered trims by snapping over receiver tabs and lightly tapping with a rubber mallet.
- B. Tolerances:
 - 1. Squareness: + 1/16 inch.
 - a. Measured on a line 90 degree from one jamb, at upper corner of frame at other jamb.
 - 2. Alignment: + 1/16 inch.
 - a. Measured on jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: + 1/16 inch.
 - a. Measured at face corners of jambs on parallel line.
 - 4. Plumbness: + 1/16 inch.
 - a. Measured on the jamb at floor.

3.2 ADJUSTING

- A. Final Adjustments:
 - 1. Check and re-adjust operating finish hardware just prior to final inspection and after painting hinges.
 - 2. Remove and replace defective work.

3.3 CLEANING

- A. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.
- B. Clean glass surfaces after installation complying with requirements contained in Section 08 80 00 - Glazing for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.
- C. Door opening assemblies shall be cleaned with general, non-abrasive cleaners suitable for painted surfaces. Wipe the surfaces with a soft, dry cloth per AAMA 609 & 610.

3.4 PROTECTION

- A. Institute protective measures required throughout remainder of construction period to ensure that aluminum frames will be without damage or deterioration, other than normal wear at time of acceptance.

END OF SECTION

SECTION 08 13 16 - ALUMINUM DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. swing doors systems.
 - 2. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

- A. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- B. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- C. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- D. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
- E. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.4 PERFORMANCE REQUIREMENTS

- A. Performance: Aluminum-framed systems shall withstand the effects of specified performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 2. Dimensional tolerances of building frame and other adjacent construction.
 - 3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Noise or vibration created by wind and by thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units.
- B. Structural Loads: Verify with Structural Engineer
 - 1. Wind Loads: As indicated on Drawings.
- C. Deflection of Framing Members:
 - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed $L/175$ of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to $L/360$ of clear span or 1/8 inch (3.2 mm), whichever is less.

- D. Structural Test Performance: Provide aluminum framed systems tested according to ASTM E330/E330M as follows:
 - 1. When tested at positive and negative wind load design pressures, systems do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E283/E283M at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).
- F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- G. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
 - 2. Interior Ambient-Air Temperature: 75 degrees F (24 degrees C).
- H. Condensation Resistance: Provide exterior aluminum framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.
- I. Thermal Conductance: Provide aluminum framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x degrees F (3.23 W/sq. m x K) when tested according to AAMA 1503.

1.5 SUBMITTALS

- A. Product Data: Technical data for each type of product indicated including construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum framed systems.
- B. Shop Drawings: Submit aluminum-framed storefront and entrance shop drawings including plans, elevations, sections, full size details, and attachments to other work.
 - 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 - 2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Door Hardware: Coordinate with Section 08 71 00 - Door Hardware.
- D. Maintenance Data: For aluminum framed systems to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessibility Requirements: Comply with applicable requirements.
 - a. U.S. Architectural and Transportation Barriers Compliance Board Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - c. Texas Accessibility Standards (TAS).

- B. Installer Qualifications: Installer having minimum 10 years documented experience who is an authorized representative of the manufacturer and is trained and approved for installation of units required.
- C. Engineering Responsibility: Prepare data for aluminum framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in service performance.
 - 1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- E. Source Limitations: Obtain aluminum-framed storefronts and entrances from single source from single manufacturer to the greatest extent possible.
- F. Pre-Installation Conference: Conduct conference at site.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

- A. Warranty: Written warranty signed by Manufacturer, Contractor, and Installer in which manufacturer agrees to repair or replace components of aluminum framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Water leakage through fixed glazing and framing areas.
 - d. Failure of operating components.
 - 2. Warranty Period: 10 years from date of Substantial Completion.
- B. Finish Warranty: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 20 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Entrance Door Hardware:
 - 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
 - 2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of ten (10) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Kawneer North America.
 - 2. Old Castle Building Envelope.
 - 3. Tubelite, Inc.
 - 4. US Aluminum Corporation.
 - 5. Vistawall.
- B. Basis of Design:
 - 1. Impact-Resistant Exterior Doors: "Insulpour 500 IR" manufactured by Kawneer.
 - 2. Thermal Doors: "Insulpour 500 T" manufactured by Kawneer.
 - 3. Non-Thermal Doors: "500 Standard Entrance" manufactured by Kawneer.
- C. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: ASTM B209/B209M.
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
 - 3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
 - 4. Structural Profiles: ASTM B308/B308M.
- D. Framing Members: Extruded aluminum framing members of thickness required and reinforced necessary to support imposed loads.
 - 1. Construction: Thermally broken for exterior conditions, non-thermal for interior conditions, unless noted otherwise.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.
- E. Accessories:
 - 1. Brackets and Reinforcements: High-strength aluminum with non-staining, non-ferrous shims for aligning system components.
 - 2. Fasteners and Accessories: Corrosion resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
 - a. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - b. Reinforce members as required to receive fastener threads.
 - 3. Concrete and Masonry Inserts: Hot dip galvanized cast iron, malleable iron, or steel inserts, complying with ASTM A123/A123M or ASTM A153/A153M.
 - 4. Concealed Flashing: Corrosion resistant, non-staining, non-bleeding flashing compatible with adjacent materials.
 - 5. Framing System Gaskets and Sealants: Recommended by manufacturer for joint type.
- F. Glazing: Refer to Section 08 80 00 - Glazing.
 - 1. Exterior Doors: Provide with insulating glazing units.
 - 2. Interior Doors: Provide with tempered glazing.
 - 3. Glazing Gaskets: Compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
 - 4. Spacers and Setting Blocks: Elastomeric type.
- G. Doors: Glazed doors for manual swing operation.
 - 1. Door Construction:

- a. Impact Resistant Doors: 1-3/4 inch (44.5 mm) overall thickness, with minimum 0.125 inch (3.2 mm) thick, extruded aluminum tubular rail and 5 inch wide stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - b. Thermal Doors: 2-1/4 inch (57.2 mm) overall thickness, with minimum 0.125 inch (3.2 mm) thick, extruded aluminum tubular rail and 5 inch wide stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - c. Non-Thermal Doors: 1-3/4 inch (44.5 mm) overall thickness, with minimum 0.125 inch (3.2 mm) thick, extruded aluminum tubular rail and 5 inch wide stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: Wide stile; 5 inch (88.9 mm) nominal width.
 3. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.
 4. Glazing Stops and Gaskets: Square, snap on, extruded aluminum stops and preformed gaskets.
- H. Door Hardware: Refer to Section 08 71 00 - Door Hardware for door hardware sets.
- I. Accessories:
1. Joint Sealants: For installation at perimeter of aluminum framed systems, refer to Section 07 92 00 - Joint Sealants.
 2. Bituminous Paint: Cold applied, asphalt mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil (0.762 mm) thickness per coat.

2.2 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Framing Members: Fabricate components that, when assembled, have specified characteristics:
 1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 4. Physical and thermal isolation of glazing from framing members.
 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
 8. Provide sill receptors with end dams at all sill conditions.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 1. At exterior doors, provide weather stripping, sweeps, and accessible thresholds.
 2. At interior doors, provide gasketing to prevent metal to metal contact.
- E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 1. At pairs of exterior doors, provide compression type weather stripping retained in adjustable strip and mortised into door edge.
 2. At exterior doors, provide weather sweeps applied to door bottoms.

- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.3 ALUMINUM FINISHES

- A. Factory Finish: Finish to match storefront, window wall, or curtain wall system in which entry system is installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and conditions affecting performance of the work. Proceed with installation after correcting unsatisfactory conditions.

3.2 INSTALLATION

- A. Comply with aluminum framed storefront manufacturer recommended installation instructions. Coordinate installation with curtain wall work.
 - 1. Do not install damaged components.
 - 2. Fit joints to produce hairline joints free of burrs and distortion.
 - 3. Rigidly secure non-movement joints.
 - 4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 5. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Install glazing as specified in Section 08 80 00 - Glazing.
- G. Entrance Doors and Hardware: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field Installed Entrance Door Hardware: Install surface mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- H. Install perimeter joint sealants as specified in Section 07 92 00 - Joint Sealants to produce weathertight installation.

3.3 ERECTION TOLERANCES

- A. Install aluminum framed systems to comply with the following maximum erection tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).

- b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.4 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
 - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70 degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION

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SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 - 1. WI Certified, fire-rated and non-rated, flush panel wood doors.
 - 2. Solid core doors with MDF and plastic laminate faces.
 - 3. Integration of a security system.
 - 4. Factory fitting flush wood doors to frames and factory machining for hardware.
 - 5. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications.
 - 2. Section 07 92 00 - Joint Sealants.
 - 3. Section 08 11 13 - Hollow Metal Doors and Frames.
 - 4. Section 08 80 00 - Glazing.
 - 5. Section 09 21 16 - Gypsum Board Assemblies.
 - 6. Section 09 24 00 - Cement Plastering.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- C. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
- D. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- E. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- F. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Technical data for each type of door indicated:
 - a. Include details of core and edge construction, louvers, and trim for openings.
 - b. Include factory finishing specifications.
 - c. Include laboratory test report results of hinge loading, cycle/slam, stile edge screw withdrawals, and stile edge split resistance for fire rated doors.
- B. Shop Drawings:
 - 1. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
 - a. Dimensions and locations of blocking.
 - b. Dimensions and locations of mortises and holes for hardware.
 - c. Dimensions and locations of cutouts.
 - d. Undercuts.
 - e. Requirements for veneer matching.
 - f. Doors to be factory finished and finish requirements.
 - g. Fire-protection ratings for fire rated doors.

- C. Certificate of Compliance for Fire Rated Doors: Provide copies of Certificate of Compliance for fire rated door assemblies and smoke and draft control door assemblies.
- D. Certificate of Compliance regarding WI construction grade.
- E. Certificate of Compliance regarding WI installation requirements.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Fire rated wood doors - NFPA 80 listed and labeled by UL for fire protection ratings indicated, based on testing at positive pressure according to UL 10C:
 - a. Oversize fire rated door assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - b. Temperature rise limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 degrees F (250 degrees C) above ambient after 30 minutes of standard fire-test exposure.
 - 2. Smoke and draft control door assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
 - 3. Accessibility requirements - comply with applicable requirements:
 - a. Americans with Disabilities Act of 1990, as amended:
 - 1) ADA Title II Regulations & the 2016 ADA Standards for Accessible Design.
 - 4. Quality standard: In addition to requirements specified, comply with Woodwork Institute WI Manual of Millwork
 - 5. Maintain at least one copy of WI Manual for reference at jobsite throughout installation period.
- B. Source Limitations: Obtain flush wood doors through one (1) source from a single manufacturer.
- C. Pre-Installation Conference: Conduct conference at site.

1.6 WARRANTY

- A. Warranty:
 - 1. Written warranty signed by manufacturer, installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship. A representative of the door manufacturer shall inspect the installed doors and shall note on the warranty that no provisions of the warranty have been nullified in the manufacture and/or installation:
 - a. Failures include, but are not limited to, the following:
 - 1) Warping (bow, cup, or twist) more than 1/4-inch (6.4 mm) in a 42-inch by 84-inch (1,067 mm by 2,134 mm) section.
 - 2) Telegraphing of core construction in face veneers exceeding 0.01-inch in a three-inch (0.25 mm in a 76.2 mm) span.
 - b. Warranty include installation and finishing that may be required due to repair or replacement of defective doors.
 - c. Warranty period for solid core exterior doors: Five (5) years from date of Substantial Completion.
 - d. Warranty period for solid core interior doors: Life of installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect wood doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Store wood doors on a flat level surface in a dry, well ventilated, place. Keep wood doors a minimum of 3-1/2 inches (85 mm) off floor surface and protected by a protective

covering under the bottom door and over the top door. Covering should protect wood doors from dirt, water, and abuse but allow for air circulation under and around the stack. Do not store wood doors in direct sunlight. Comply with requirements of referenced standard and manufacturer's written instructions.

- B. Package doors individually in heavy duty cardboard cartons prior to shipment from factory. Mark each door on top and bottom rail with opening number used on shop drawings using temporary, removable, or concealed markings.
- C. Handle wood doors with clean gloves. Lift and carry wood doors when moving them around the site; do not drag wood doors across one another.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Flush Wood Doors:
 - a. Haley Brothers, Inc.
 - b. Oshkosh Door Company.
 - c. Oregon Door.
 - d. Weyerhaeuser.
 - 2. High Pressure Laminate:
 - a. Formica Corp.
 - b. Panolam Surface Systems.
 - c. Wilsonart LLC.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 MATERIALS

- A. Fire Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Cores: Provide core specified or mineral core as necessary to provide fire protection rating indicated.
 - 2. Edge construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - 3. Pairs: Provide fire retardant stiles listed and labeled for applications indicated without formed steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
 - 4. Pairs:
 - a. Provide formed steel edges and astragals with intumescent seals:
 - 1) Finish steel edges and astragals with baked enamel same color as doors.
 - 2) Finish steel edges and astragals to match door hardware (locksets or exit devices).
- B. Smoke and Draft Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- C. Particleboard Core Doors:
 - 1. Blocking:
 - a. Provide wood blocking in particleboard core doors as necessary to eliminate through-bolting hardware:
 - 1) Five-inch (125 mm) top rail blocking in all doors, whether or not closers are scheduled.

- 2) Five-inch (125 mm) bottom rail blocking, in exterior doors and doors indicated to have protection plates.
 - 3) Five-inch (125 mm) midrail blocking, in doors indicated to have exit devices.
 - 4) 4-1/2 inch by 10 inch (114 mm by 250 mm) lock blocks, in doors indicated with lock and latch sets.
2. Provide doors with glued wood stave or structural composite lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- D. Fire Rated Wood Doors with Plastic Laminate Face - Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C:
1. Core: Noncombustible mineral product complying with requirements and testing and inspecting agency for fire protection rating indicated.
 2. Blocking:
 - a. Provide composite blocking with improved screw-holding capability approved for use in doors of fire protection ratings indicated as follows:
 - 1) 5 inch (125 mm) top rail blocking in all doors, whether or not closers are scheduled.
 - 2) 5 inch (125 mm) bottom rail blocking, in doors indicated to have protection plates.
 - 3) 5 inch (125 mm) midrail blocking, in doors indicated to have exit devices.
 - 4) 4-1/2 inch by 10 inch (114 mm by 250 mm) lock blocks, in doors indicated with lock and latch sets.
 3. Edge Construction:
 - a. Provide fire rated door edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges:
 - 1) At hinge stiles, provide laminated edge construction with improved screw holding capability and split resistance:
 - (a) Screw holding capability: 550 lbf (2440 N) per WDMA T.M.-10.
 - 2) Pairs:
 - (a) Provide fire retardant stiles listed and labeled for applications indicated without formed steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges. Where required, provide formed steel edges and astragals with intumescent seals. Finish steel edges and astragals with baked enamel.
 4. Smoke and draft control door assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

2.3 PLASTIC-LAMINATE-FACED DOORS

- A. Particleboard Core Doors with Plastic Laminate Face:
1. Grade and construction: WI custom grade, PC-5; 1-3/4 inch unless otherwise indicated.
 2. Core - ANSI A208.1, particleboard or MDF, made with binder containing no urea formaldehyde resin: Provide doors with glued block or structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated.
 3. Blocking:
 - a. Provide wood blocking in particleboard core doors necessary to eliminate through bolting hardware:
 - 1) Five-inch (125 mm) top rail blocking. in all doors, whether or not closers are scheduled.
 - 2) Five-inch (125 mm) bottom rail blocking in doors indicated to have protection plates.
 - 3) Five-inch (125 mm) midrail blocking, in doors indicated to have exit devices.
 - 4) 4-1/2-inch by ten-inch ((114 mm by 250 mm)) lock blocks, in doors indicated with lock and latch sets.

4. Exposed Vertical and Horizontal Edges:
 - a. Material: Plastic laminate.
 - 1) Finish: Match face.
5. Construction: Five (5) plies. Bond stiles and rails to core, then abrasive plane entire unit before faces and crossbands are applied. Bond faces to core using a hot press.
6. Crossbanding: Minimum 1/16-inch thick, low density hardwood, composite, or high density hardboard.
7. Face: 3-ply AWI PC-HPDL-3 High Pressure Decorative Laminate (HPDL).
 - a. Finish: PL-3.

2.4 WOOD VENEER-FACED DOORS (TRANSPARENT FINISH)

- A. Particleboard Core Doors with Wood Veneer Face:
 1. Grade and construction: WI custom grade, PC-5; 1-3/4 inch unless otherwise indicated.
 2. Core - ANSI A208.1, particleboard or MDF, made with binder containing no urea formaldehyde resin: Provide doors with glued block or structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated.
 3. Blocking:
 - a. Provide wood blocking in particleboard core doors necessary to eliminate through bolting hardware:
 - 1) 5 inch (125 mm) top rail blocking, in all doors, whether or not closers are scheduled.
 - 2) 5 inch (125 mm) bottom rail blocking in doors indicated to have protection plates.
 - 3) 5 inch (125 mm) midrail blocking, in doors indicated to have exit devices.
 - 4) 4-1/2 inch by 10 inch (114 mm by 250 mm) lock blocks, in doors indicated with lock and latch sets.
 4. Exposed Vertical and Horizontal Edges:
 - a. Material: Wood veneer.
 - 1) Finish: Match face.
 5. Construction: Five (5) plies. Bond stiles and rails to core, then abrasive plane entire unit before faces and crossbands are applied. Bond faces to core using a hot press.
 6. Crossbanding: Minimum 1/16-inch thick, low density hardwood, composite, or high density hardboard.
 7. Face: Wood Veneer.
 - a. Species: Red Oak.
 - b. Cut: Rift Cut.
 - c. Matching: Center.
 - d. Finish: Timber Stain.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated:
 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame shop drawings, BHMA-156.115-W, and hardware templates:
 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 2. Metal astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Transom and Side Panels:
 1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of

rabbeted doors same as door stiles:

- a. Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.
- D. Openings:
1. Factory cut and trim openings through doors:
 - a. Light openings: Trim openings with moldings of material and profile indicated.
 - b. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 - Glazing.
 - c. Louvers: Factory install louvers in prepared openings.
- E. Exterior Doors:
1. Factory treat exterior doors with water repellent after fabrication has been completed but before shop priming or factory finishing:
 - a. Flash top of out-swinging doors with manufacturer's standard metal flashing.

2.6 SHOP PRIMING

- A. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one (1) coat of wood primer specified in Section 09 90 00 - Painting and Coating.
- B. Doors for Transparent Finish: Shop prime faces and all four edges with stain (if required), other required pretreatments, and first coat of finish as specified in Section 09 90 00 - Painting and Coating. Seal edges of cutouts and mortises with first coat of finish.

2.7 FACTORY FINISHING

- A. General – For factory finish doors, factory finish doors that are indicated to receive transparent finish, and factory finish doors where indicated in schedules or on Drawings as factory finished:
 - a. Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing:
 - 1) Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Transparent Finish:
 1. Grade: Premium.
 2. Finish: WI's Architectural Woodwork Standards System 9, UV curable, acrylated epoxy, polyester, or urethane; refer to Drawings for finish designation.
 3. Staining: As selected by Architect from manufacturer's full range.
 4. Effect: Semi-filled finish, produced by applying an additional finish coat to partially fill the wood pores.
 5. Sheen: Semigloss.
- C. Opaque Finish:
 1. Grade: Premium.
 2. Finish: AWMAC's and WI's Architectural Woodwork Standards System 10, UV curable, water based; refer to Drawings for finish designation.
 3. Color: As selected by Architect from manufacturer's full range.
 4. Sheen: Semigloss.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

3.2 EXAMINATION

- A. Examine doors and installed door frames, with installer present, before hanging doors:
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Hardware: For installation, refer to Section 08 71 00 - Door Hardware.
- B. Installation Instructions:
 - 1. Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated:
 - a. Install fire-rated doors according to NFPA 80.
 - b. Install smoke and draft-control doors according to NFPA 105.
- C. Job-Fitted Doors:
 - 1. Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining:
 - a. Clearances:
 - 1) Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 3/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated:
 - (a) Comply with NFPA 80 for fire-rated doors.
 - b. Bevel non-fire-rated doors 1/8 inch in two inches (2") - 3-1/2 degrees - at lock and hinge edges.
 - c. Bevel fire-rated doors 1/8 inch in 2 inches - 3-1/2 degrees- at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.4 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

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SECTION 08 17 53 - INTEGRATED GLASS DOOR OPENING ASSEMBLIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Factory-assembled and factory-finished oversized glass entryway applications including, but not limited to the following:
 - a. Glass doors.
 - b. Hardware.
- B. Related Sections:
 - 1. Section 08 71 00 - Door Hardware: Certain other hardware to be installed on these doors.

1.3 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- C. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2023.
- D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023.
- E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- H. ASTM B455/B455M - Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes; 2020.
- I. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- J. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- K. {RSTEMP#623}ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass{CH#190484}.
- L. BHMA A156.3 - Exit Devices; 2020.
- M. BHMA A156.4 - Door Controls - Closers; 2019.
- N. BHMA A156.13 - Mortise Locks & Latches Series 1000; 2022.
- O. BHMA A156.26 - Continuous Hinges; 2021.
- P. ITS (DIR) - Directory of Listed Products; Current Edition.
- Q. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
- D. Hardware Schedule: Detailed list of each hardware item to be provided on each door; coordinate hardware furnished by others.
- E. Samples: Submit two samples of metal, 2 by 2 inch (51 by 51 mm) showing factory finishes and colors.
- F. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in accordance with manufacturer's instructions.
- B. Store in clean, dry, ventilated space having controlled temperature and relative humidity between 30 and 60 percent.
- C. Stack doors flat and off the floor to prevent warping.

1.7 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Provide manufacturer's standard warranty against defects in material and workmanship:
 - 1. Provide two year warranty against defects in material and workmanship for entire door opening assembly.
 - 2. Provide lifetime limited warranty for locksets, hanger rods, and panic exit devices.
 - 3. Do not void warranty by failing to store units as recommended prior to installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Avanti Systems USA, Inc; www.avantisystemsusa.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 BASIS OF DESIGN

- A. Products manufactured by Avanti Systems USA, Inc.

2.3 MATERIALS

- A. Glass:
 - 1. Tempered Glass: Annealed flat glass meeting requirements of ASTM C1036, Type 1-Transparent Flat, Class 1-Clear, Quality Q3, and fully tempered in accordance with ASTM C1048, Kind FT.
 - a. Thickness: 3/8 inch (9.5 mm).

- b. Prepare glazing panels for indicated fittings and hardware before tempering.
 - c. Provide exposed glazing edges with flat polished/ground glass finish.
 - d. Temper glass materials horizontally; visible tong marks or tong mark distortions are not permitted.
2. Laminated Glass: Fully tempered float glass laminated in accordance with {RS#623}, with eased and polished edges.
 - a. Plastic Interlayer: 0.060 inch (1.52 mm) thick, minimum.
 - b. Thickness: 3/8 inch (9.5 mm).
- B. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- C. Bronze Fittings: ASTM B455/B455M, alloy UNS No. C38500.
- D. Steel: ASTM A1008/A1008M or ASTM A1011/A1011M.
- E. Stainless Steel Fittings: ASTM A276/A276M, Type 304, satin finish.
- F. Gaskets: Molded or extruded shape to fit glazing channel retaining slot.
- G. Fasteners: Type suitable to application and acceptable to assembly manufacturer.
- H. Door, Frame, and Hardware Assemblies: Provide fully functional, factory-assembled and factory-finished door opening units, complete with door, frame, and hardware; complying with specified requirements.
 1. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- I. Performance Requirements: Comply with requirements of Authorities Having Jurisdiction (AHJ), and the following:
 1. Force to Open, Close and Latch: Not more than 5 pounds (22.2 N) to open or close latch and not more than 15 pounds (66.6 N) to set door in motion.
 2. Fire Rating(s): As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
 - a. Provide units listed and labeled by ITS (DIR) as a door and frame assembly.
 - b. Attach fire rating label to each fire rated unit.

2.4 COMPONENTS

- A. Door Frames: Formed steel cased opening (no stop required); electrogalvanized prior to finishing.
- B. Hinges: Full height, formed steel, semi-concealed, dual pivot point, 180 degree swing; BHMA A156.26, Grade 1, with not less than 5,000,000 cycle testing; door manufacturer's standard paint finish; provide for doors as indicated.
- C. Handle Pull: Stainless steel pipe, 1 inch (25.4 mm) diameter.
 1. Height: Full door height.
 2. Glass Standoff Pipe: 1-9/16 inch (39.7 mm) by 3/4 inch (19 mm) diameter.
 3. Standoff End Closure: 1-3/16 inch (30.2 mm) diameter disk.
 4. Locking Handle: 1-9/16 inch (39.7 mm) by 1-9/16 inch (39.7 mm) diameter.
 5. Locking Handle End Closure: 1-9/16 inch (39.7 mm) diameter disk.
- D. Latch Stile: Full height, formed steel latch channel and concealed operating mechanism; door manufacturer's standard paint finish; provide for all doors.
 1. Mortise Locks/Latches: BHMA A156.13, Grade 1, with not less than 5,000,000 cycle testing.
 2. Locking/Latching Functions: To suit occupancy; to be selected from door manufacturer's standard functions.
 3. Pairs: Interlocking meeting stiles and strike on head of frame; foot strike only where indicated.
 4. Single Doors: Full height latch stop on frame jamb; top and bottom latch strikes.

- E. Door Closers: Concealed overhead, cam-action track mounted in top of door; 135 degree swing, positive stop; adjustable sizing, latching, and closing speed; BHMA A156.4, Grade 1.
 - 1. Normally Closed Doors: Entire closer including arm concealed when door is closed.
 - 2. Normally Open Doors: Entire closer including arm concealed when door is open.
 - 3. Provide for all fire-rated doors and other doors where indicated.
- F. Door Closers: Surface mounted on door; modern style cover; minimum 90 degree swing, positive stop, adjustable sizing, latching, and closing speed; BHMA A156.4, Grade 1.
 - 1. Locate on room side of corridor doors and inside of exterior doors; provide parallel arm where required.
- G. Exit Devices: Flush-panel type, recessed into door; extruded aluminum, natural anodized finish.
 - 1. Projection From Face of Door: Maximum of 1/8 inch (3 mm) when door is open, minimum of 5/8 inch (16 mm) when closed.
 - 2. Complying with BHMA A156.3 with not less than 5,000,000 cycle testing.
 - 3. Face Insert: To match door finish.
- H. Push Pad Devices: Surface applied type; extruded aluminum, natural anodized finish.
 - 1. Size: Nominal 7 inches (178 mm) high and wide, 1-5/16 inch (33 mm) maximum projection.
 - 2. Provide where indicated.
- I. Lever Trim: To operate manufacturer's standard locking/latching mechanism; lever design selected from door manufacturer's full line; rectangular escutcheon.
 - 1. Material and Finish: Satin stainless steel.
- J. Grip Trim: To operate manufacturer's standard locking/latching mechanism; pull design selected from door manufacturer's full line; natural anodized finish; no exposed fasteners.
- K. Lock Cylinders: Standard mortise type; furnished by door hardware supplier; factory installed.
 - 1. Provide for all exterior doors unless otherwise indicated.
- L. Floor Bolt: Sealed end socket, 1-1/4 inch (31.8 mm) long by 1 inch (25.4 mm) diameter.
- M. Protection Plates: Full door width, bonded to door face and edges.
 - 1. Material and Finish: As selected by Architect.
 - 2. Door Edging: Stainless steel; rivet fasteners.
 - a. Provide where indicated only.

2.5 FINISHES

- A. High Performance Organic Coatings: AAMA 2604; multiple coats, thermally cured fluoropolymer system.
 - 1. Color: RAL 9006 Metallic Silver.
 - 2. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's requirements and as necessary to achieve performance characteristics specified.
- B. Coordinate frame anchor placement with wall construction.
- C. Coordinate installation of electrical connections to electrical hardware items.
- D. Touch up damaged factory finishes.

3.3 TOLERANCES

- A. Clearances Between Door and Frame: As specified in ANSI/SDI A250.8 (SDI-100).
- B. Maximum Diagonal Distortion: 1/16 inch (1.5 mm) measured with straight edge, corner to corner.

3.4 ADJUSTING

- A. Adjust for smooth and balanced door movement.

END OF SECTION

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SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electric operators and control stations.
 - 2. Wiring from electric circuit disconnect to operators and control stations.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications: Door opening jamb and head members.
 - 2. Section 06 10 00 - Rough Carpentry: Door opening jamb and head members.
 - 3. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
 - 4. Section 08 31 00 - Access Doors and Panels: Access doors.
 - 5. Section 09 90 00 - Painting and Coating: Field paint finish.
 - 6. Division 26: Power to disconnect.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test; 2022.
- D. ITS (DIR) - Directory of Listed Products; Current Edition.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- F. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- G. UL (DIR) - Online Certifications Directory; Current Edition.
- H. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide general construction, electrical equipment, and component connections and details.
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
- D. Samples: Submit two slats, 6 inches (610 mm) in size illustrating shape, color and finish texture.
- E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.
- F. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.
- G. Executed warranties.

- H. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years documented experience and approved by manufacturer.
- C. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Manufacturer Warranty: Provide five-year manufacturer warranty for three-ply multifilament polyester fabric curtain. Complete forms in Owner's name and register with manufacturer.
- C. Manufacturer Warranty: Provide lifetime manufacturer warranty for counterweights and tension springs. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. Overhead Coiling Doors:
 - a. Alpine Overhead Doors, Inc: www.alpinedoors.com.
 - b. Amarr: www.amarr.com/commercial.
 - c. C.H.I. Overhead Doors: www.chiohd.com.
 - d. Clopay Building Products: www.clopaydoor.com.
 - e. Cornell Iron Works, Inc: www.cornelliron.com.
 - f. Hörmann High Performance Doors: www.hormann.us.
 - g. Overhead Door Corporation: www.overheaddoor.com.
 - h. Raynor Garage Doors: www.raynor.com.
 - i. Rite-Hite Corp: www.ritehite.com.
 - j. The Cookson Company: www.cooksondoor.com.
 - k. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com.
 - B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 OVERHEAD COILING DOORS

- A. Overhead Coiling Door: Steel slat curtain.
1. Basis of Design:
 - a. Model ESD10 manufactured by Cornell Iron.
 2. Curtain:
 - a. Slats:
 - 1) Galvanized Steel: No. 5F (prefinished), Grade 40 steel, ASTM A653/A653M galvanized steel zinc coating. Gauge as required to meet performance requirements.
 - b. Finish:
 - 1) Powder Coat.
 - (a) Color: As selected by Architect from manufacturer's full line.
 3. Endlocks:

- a. Alternate slats each secured with two 1/4 inch (6.35 mm) rivets. Fabricate interlocking sections with high strength nylon. Provide endlocks/windlocks as required to meet specified wind load.
4. Bottom Bar:
 - a. Configuration:
 - 1) Extruded Aluminum: Extruded aluminum alloy 6063-T5.
 - 2) Structural Steel Angles.
 - 3) Structural Aluminum Angles.
 - 4) Heavy Duty Aluminum Bottom Bar: 6 by 2 by 3/8 inches impact resistant tubular extrusion.
 - b. Finish:
 - 1) Aluminum: Mill.
 - 2) Powder Coat: Zirconium pre-treatment followed by baked-on polyester powder coat. minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D-3363 pencil hardness: H or better.
 - (a) Color: As selected by Architect from manufacturer's full line.
 - 3) Corrosion Inhibitive: Zirconium treatment followed by a corrosion inhibitive baked-on zinc enriched gray polyester powder coat; minimum 2.5 mils (0.065 mm) cured film thickness.
 - 4) Hot-dip Galvanized: ASTM A123/A123M, Grade 85 zinc coating, hot-dip galvanized after fabrication.
 - 5) Stainless Steel: #4 brushed finish.
5. Counterbalance Shaft Assembly:
 - a. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot (2.5 mm per meter) of width.
 - b. Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs. (110 N). Provide wheel for applying and adjusting spring torque.
6. Brackets:
 - a. Fabricate from minimum 3/16 inch (5 mm) steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures.
 - b. Finish:
 - 1) Powder Coat: Zirconium pre-treatment followed by baked-on polyester powder coat. minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D3363 pencil hardness: H or better.
 - (a) Color: As selected by Architect from manufacturer's full line.
 - 2) Corrosion Inhibitive: Zirconium treatment followed by a corrosion inhibitive baked-on zinc enriched gray polyester powder coat; minimum 2.5 mils (0.065 mm) cured film thickness.
 - 3) Hot-dip Galvanized: ASTM A123/A123M, Grade 85 zinc coating, hot-dip galvanized after fabrication.
 - c. Hood:
 - 1) Galvanized steel with reinforced top and bottom edges. Provide intermediate support brackets as required.
 - 2) Finish:
 - (a) Powder Coat: Zirconium pre-treatment followed by baked-on polyester powder coat. minimum 2.5 mils (0.065 mm) cured film thickness; ASTM D3363 pencil hardness: H or better.
 - (1) Color: As selected by Architect from manufacturer's full line.
 - (b) Corrosion Inhibitive: Zirconium treatment followed by a corrosion inhibitive baked-on zinc enriched gray polyester powder coat; minimum 2.5 mils (0.065 mm) cured film thickness.

- (c) Hot-dip Galvanized: ASTM A123/A123M, Grade 85 zinc coating, hot-dip galvanized after fabrication.
- 7. Weatherstripping:
 - a. Bottom Bar: Replaceable, bulb-style, compressible EDPM gasket extending into guides.
 - b. Guides: Vinyl strip sealing against fascia side of curtain.
 - c. Hood: Neoprene/rayon baffle to impede air flow above coil.
 - d. Lintel Seat: Nylon brush seal fitted at door header to impede air flow.
- 8. Operation:
 - a. Motor: As recommended by manufacturer.
 - 1) Rating: Minimum of 2cycles per hour.
 - 2) Lifecycles: 50,000 cycles.
 - 3) Control Stations:
 - (a) Model: Manufacturer's standard.
 - (b) Location: As indicated on Drawings.
 - 4) Safety Devices: As recommended by manufacturer to comply with applicable regulations.
- 9. Locking:
 - a. None.

2.3 MATERIALS AND COMPONENTS

- A. Metal Curtain Construction: Interlocking slats.
 - 1. Curtain Bottom for Slat Curtains: Fitted with angles to provide reinforcement and positive contact in closed position.
 - 2. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.
- B. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.

2.4 ELECTRIC OPERATION

- A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
 - 1. Provide interlock switches on motor operated units.
- B. Electric Operators:
 - 1. Mounting: Side mounted.
 - 2. Motor Enclosure:
 - 3. Motor Rating: 1/3 HP (250 W); continuous duty.
 - 4. Motor Voltage: 120 volts, single phase, 60 Hz.
 - 5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
 - 6. Controller Enclosure: NEMA 250, Type 4.
 - 7. Opening Speed: 12 inches per second (300 mm/sec).
 - 8. Brake: Manufacturer's standard type, activated by motor controller.
 - 9. Manual override in case of power failure.
 - 10. See Section 26 05 83 for electrical connections.
- C. Control Station: Provide standard three button, 'Open-Close-Stop' momentary-contact control device for each operator complying with UL 325.
 - 1. 24 volt circuit.
 - 2. Surface mounted, at interior door jamb.
 - 3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
 - a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control

device.

- D. Safety Edge: Located at bottom of coiling door, full width, electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object, hollow neoprene covered.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 26 05 83.
- F. Complete wiring from disconnect to unit components.

END OF SECTION

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SECTION 08 33 43 - FIRE AND SMOKE RATED CURTAINS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. General Requirements:
 - 1. Provide all materials, labor, equipment, and services necessary to furnish, deliver, and install all work under this Section as shown on the Contract Documents, specified herein, and as specified by the job conditions.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications.
 - 2. Section 06 10 00 - Rough Carpentry.
 - 3. Section 08 31 13 - Access Doors and Frames.
 - 4. Section 09 90 00 - Painting and Coating.
 - 5. Division 26 - Electrical.

1.3 SUBMITTALS

- A. Procedures: Furnish submittals in accordance with the general requirements specified.
- B. Shop Drawing: Furnish shop drawings for Architect's approval. Include elevations, sections, and details indicating dimensions, materials, finishes, and conditions for anchorage and support of each fire and smoke rated curtain.
- C. Product Literature: Submit manufacturer's technical literature describing the product to be used under this Section.
- D. Maintenance and Operating Manuals: Furnish complete manuals describing the materials, devices, and procedures to be followed in operating and maintaining all of the fire and smoke rated curtains under this Section. Include manufacturer's brochures and parts lists describing the actual materials used in the product.
- E. Product Approval Reports: Submit copy of manufacturer's Listing Report and Authorization To Mark clearly detailing the description of product, fire endurance test method, test results, and test conclusions of the test criteria as conducted and witnessed by a United States accredited testing laboratory such as Underwriters Laboratories (UL) or Intertek-Warnock Hersey (Intertek). Testing agency's Listing Report shall clearly state that the fire and smoke rated curtains have been tested and approved to the standards and criteria of UL 10B and UL 10C (20 minutes), UL 10D (3 hours) and UL 1784 smoke and draft rating without the use of an artificial bottom seal.

1.4 QUALITY ASSURANCE

- A. Fire and Smoke Rated Assemblies: Provide all curtains with fire and smoke resistance rating required to comply with governing regulations, which are inspected, tested, listed, and labeled by UL or Intertek and complying with NFPA 80 for class of opening. Provide units tested, approved, and labeled under the UL 10B, UL 10C, UL 10D, and UL 1784 standards. Provide testing laboratory label permanently affixed to each fire curtain bottom bar assembly as evidence of product compliance in accordance with the requirements outlined under NFPA 80.
- B. Oversize Assemblies: Where units exceed the testing laboratory's label size, an oversize certificate label issued by either UL or Intertek shall be provided and permanently affixed to each fire curtain bottom bar assembly as evidence of product compliance. Oversize assemblies requiring the joining of curtain sections together onsite by the installer must require documented field certification by UL or Intertek.

- C. Electric Motor Drives and Control Equipment: Tested, listed, and labeled under standards UL 325 and UL 864. Provide testing laboratory label permanently affixed to each fire curtain control panel as evidence of product compliance.
- D. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of federal, state, and municipal authorities having jurisdiction.

1.5 WARRANTY

- A. Fire and Smoke Rated Curtain Warranty: Provide two (2) year warranty signed by the manufacturer and installer agreeing to repair or replace work that has failed as a result of defects in materials or workmanship. Upon notification within the warranty period, such defects shall be repaired at no cost to the Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver and store materials in manufacturer's original packaging, labeled to show name, brand, and type. Store materials in a protected dry location off the ground in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 FIRE AND SMOKE RATED CURTAINS

- A. Manufacturer:
 - 1. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - a. McKeon.
- B. Basis of Design: FireFighter® Series model D200 as manufactured by McKEON.

2.2 MATERIALS

- A. Assembly Design: Shall be designed requiring a single motor power drive to operate the curtain assembly and all its overlapping curtain sections. Fire and smoke curtain assemblies requiring more than one motor drive unit to operate the curtain assembly and its overlapping curtain sections are not acceptable.
- B. Curtain: Shall be of a reinforced fabric curtain, consisting of a fiberglass fabric with integral stainless steel wire weave and 1 hour fire retardant coating. Curtain shall be at minimum no less than 0.54 mm thick.
- C. Bottom Bar: Shall consist of a tubular member formed to fit curtain, provide stiffness, limit deflection, and allow for a tight-fitting closure. Bottom bar shall be designed of adequate size and weight to keep the curtain fully extended, taut, and level during self-closing while preventing any deflection caused by the building's air pressure currents.
- D. Guide Assemblies: Each guide assembly shall be fabricated of a steel mounting adjustment angle and with integral pressure retaining side guides. The side guides are to be designed with an overall viewable exposed profile of no greater than 3/8-inch in width.
- E. Endplates: Fabricated of minimum 14-gauge steel endplates provided to house and support ends of the barrel assembly.
- F. Hood: Shall be provided to entirely enclose curtain and barrel assembly. Hood shall be fabricated of minimum 22-gauge G90 galvanized steel formed to match brackets. Top and bottom shall be bent and reinforced for stiffness. Hood shall be fitted with UL approved and classified smoke seals.
- G. Barrel Assembly: Fabricated of structural quality carbon steel seamless pipe of sufficient size and diameter to house operating motor drive, support curtain assembly, and limit horizontal deflection of the fire and smoke curtain assembly.

- H. Single Motor Drive Unit:
 - 1. Fire and smoke rated curtain shall be powered by a single motor drive design including gearbox assembly, electromechanical distance travel limit switches all linked to an internal electromagnetic brake that allows the draft curtain to operate under normal and fire ready conditions. Motor drive units shall be listed and labeled to test standards UL 325 and UL 864:
 - a. Control station: Provide surface mount push button control station marked Open, Close, and Stop.
 - I. Fail-Safe Release Device: A fail-safe release device shall be built into the motor drive unit as an integral part of the release mechanism. When power is interrupted to the release mechanism by an alarm condition, the fire and smoke curtain shall automatically self-close. In the event of power failure, a time delay shall prevent the fire and smoke curtain from closing for a period of 30 minutes, unless there is an alarm condition, at which point the fire and smoke curtain shall immediately self-close. Once power has been restored and the alarm condition has been cleared, the release mechanism shall automatically reset, and the fire and smoke curtain shall immediately be restored to the normal operating condition.
 - J. True Test Panel: Fire and smoke curtains shall be provided with a True Test panel. A single True Test panel shall activate and automatically reset all the fire and smoke curtains on the Project. When activated to close via the True Test panel, the fire and smoke curtains shall self-close under gravity, not power, in accordance with the requirements outlined under NFPA 80 Standard for Fire Doors and Other Opening Protectives.
 - K. Finish: After completion of fabrication, clean all metal surfaces to remove dirt and chemically treat to provide for paint adhesion. Hood, guides, and bottom bar shall be of McKeon Sterling Gray finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and field conditions to which this work is to be performed and notify Architect if conditions of surfaces exist that are detrimental to proper installation and timely completion of work.
- B. Verify all dimensions taken at jobsite affecting the work. Notify Architect in any instance where dimensions vary.
- C. Coordinate and schedule work under this Section with work of other Sections so as not to delay job progress.

3.2 INSTALLATION

- A. Perform installation using only factory approved and certified representatives of the fire and smoke curtain manufacturer.
- B. Install fire and smoke curtain assemblies at locations shown in perfect alignment and elevation, plumb, level, straight, and true.
- C. Adjust fire and smoke curtain installation to provide uniform clearances and smooth non-binding operation.
- D. Install wiring in accordance with applicable local codes and the National Electrical Code Standard. Materials shall be UL listed.
- E. Test fire and smoke curtain closing sequence when activated by the building's fire alarm system. Reset fire and smoke curtain after successful test.

3.3 PROTECTION AND CLEANING

- A. Protect installed work using adequate and suitable means during and after installation until accepted by Owner.
- B. Remove, repair, or replace materials that have been damaged in any way.

- C. Clean surfaces of grime and dirt using acceptable and recommended means and methods.

END OF SECTION

SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

- A. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications: Steel attachment devices.
 - 2. Section 07 27 26 - Fluid-Applied Air Barrier Systems: Sealing framing to water-resistive barrier installed on adjacent construction.
 - 3. Section 07 84 13 - Penetration Firestopping: Firestop at system junction with structure.
 - 4. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
 - 5. Section 08 80 00 - Glazing.

1.3 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- C. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- D. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- E. ASTM E413 - Classification for Rating Sound Insulation; 2022.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.
- C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

1.7 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Provide mock-up including each component being used on the project. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
- C. Locate on-site where directed by Architect; mock-up may remain as part of the Work.
- D. Locate off-site where directed, and remove when directed.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.

- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.9 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.10 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 1. Kawneer North America: www.kawneer.com/#sle.
 2. Oldcastle Building Envelope: www.oldcastlebe.com/#sle.
 3. Tubelite, Inc: www.tubeliteinc.com/#sle.
 4. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
 5. Wausau Window and Wall Systems: www.wausauwindow.com/#sle.

2.2 BASIS OF DESIGN

- A. Model 1600 WallSystem 1 manufactured by Kawneer.

2.3 CURTAIN WALL

- A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 1. Outside glazed, with pressure plate and mullion cover.
 2. Fabrication Method: Either shop/factory or field fabricated system.
 3. Glazing Method: Either shop/factory or field glazed system.
 4. Vertical Mullion Dimensions: 2-1/2 inches wide by 7-1/2 inches deep.
 5. Finish: Class I natural anodized.
 - a. Factory finish surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 6. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 7. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 8. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
 1. Design Wind Loads: Refer to Structural.

- a. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
 - b. Member Deflection: For spans less than 13 feet 6 inches (4115 mm), limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch (19 mm), whichever is less and with full recovery of glazing materials.
 - c. Member Deflection: For spans over 13 feet 6 inches (4115 mm) and less than 40 feet (12.2 m), limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch (1/240 of span plus 6.4 mm), with full recovery of glazing materials.
2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
- a. Expansion and contraction caused by 180 degrees F (82 degrees C) surface temperature.
 - b. Expansion and contraction caused by cycling temperature range of 170 degrees F (77 degrees C) over a 12 hour period.
 - c. Movement of curtain wall relative to perimeter framing.
 - d. Deflection of structural support framing, under permanent and dynamic loads.
- C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
1. Test Pressure Differential: 10 psf (480 Pa).
- D. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.27 psf (300 Pa) pressure difference across assembly.
- E. Thermal Performance Requirements:
- F. Acoustical Performance Requirements:
1. Sound Attenuation: STC of ____, minimum, from exterior to interior.

2.4 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
- B. Glazing:
 1. Types: Refer to Section 08 80 00 - Glazing.
 2. Locations: As indicated on Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install curtain wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

END OF SECTION

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SECTION 08 71 00

FINISH HARDWARE

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

- A. Work under this section comprises of furnishing and installing hardware specified herein and noted on drawings for a complete and operational system, including any electrified hardware components, systems, controls and hardware for aluminum entrance doors. Any door shown on the drawing and not specifically referenced in the hardware sets shall be provided with identical hardware as specified on other similar openings and shall be included in the finish hardware suppliers bid. All fire rated door shall be provided with fire rated hardware as required by local code Authority as part of the hardware supplier's base bid. The hardware supplier shall coordinate with all affected suppliers as required to insure a functional card access system.
- B. The Hardware Supplier shall notify the Architect in writing of any discrepancies (five (5) days prior to bid date) that could and/or would result in hardware being supplied that is none functional, hardware specified and/or hardware that has not been specified that will result in any code violations and any door that is not covered in this specification. Failure of the hardware supplier to address any such issue shall be considered acceptance of the hardware specified and all discrepancies shall be corrected at the hardware supplier's expense and considered a part of their base bid. Change orders shall not be issued if deemed by the Architect and/or Alamo College District to fall under and/or be covered as a part of the supplier's base bid, due to failure to comply with this instruction notification.
- C. Items include but are not limited to the following:
1. Hinges & Continuous Hinges
 2. Flush Bolts
 3. Exit Devices
 4. Locksets and Cylinders
 5. Push Plates – Pulls
 6. Coordinators
 7. Closers
 8. Kick, Mop and Protection Plates
 9. Stops, Wall Bumpers, Overhead Controls
 10. Electrified Hold Open Devices
 11. Thresholds, Seals and Door Bottoms
 12. Silencers
 13. Miscellaneous Trim and Accessories
 14. Wiring Diagrams
 15. Installation of all Finish Hardware

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of contract, including General and Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.03 RELATED WORK

Specified elsewhere that should be examined for its effect upon this section:

- A. Section 06 20 00 – Finish Carpentry
- B. Section 08 12 14 – Standard Steel Frames.
- C. Section 08 13 14 – Standard Steel Doors.
- D. Section 08 14 16 – Flush Wood Doors.
- E. Section 08 41 13 – Aluminum-Framed Entrances and Storefronts.
- F. Division 28 – Card Access Control
- G. Division 26 – Electrical

1.04 REFERENCES SPECIFIED

In this section subject to compliance as directed:

- A. NFPA-80 - Standard for Fire Doors and Windows
- B. NFPA-101 - Life Safety Code
- C. ADA - The Americans with Disabilities Act - Title III - Public Accommodations
- D. ANSI-A 117.1 - American National Standards Institute - Accessible and Usable Buildings and Facilities
- E. ANSI-A 156.5 - American National Standards institute -Auxiliary Locks and Associated Products
- F. UFAS - Uniform Federal Accessibility Standards
- G. UL - Underwriter's Laboratories
- H. WHI - Warnock Hersey International, Testing Services
- I. State and Local Codes including Authority Having Jurisdiction
- J. UL10C – Positive Pressure
- K. IBC-2021 - International Building Code
- L. BHMA – Builder's Hardware Manufacturer's Association
- M. DHI – Door and Hardware Institute
- N. NFPA-70 – National Electrical Code

1.05 SUBMITTALS

- A. Hardware Schedules:
 - 1. Submit copies of schedule in accordance with Division 1, General Requirements. Schedule to be in vertical format, listing each door opening, including: handing of opening, all hardware scheduled for opening or otherwise required to allow for proper function of door opening as intended, and finish of hardware. At doors with door closers or door controls include degree of door opening. Supply the schedules all Finish Hardware within two (2) weeks from date purchase order is received by the hardware supplier.
- B. Submit manufacturer's cut/catalog sheets on all hardware items and any required special mounting instructions with the hardware schedule.
- C. Certification of Compliance:
 - 1. Submit any information necessary to indicate compliance to these specifications as required.
- D. Submit any samples necessary as required by the Architect.
- E. Templates for finish hardware items to be sent to related door and frame suppliers within three (3) working days of receipt of approved hardware schedule.

- F. Electronic Security Hardware: Coordinate installation of the electronic security with the Architect and provide installation and technical data to the Architect and other related sub-contractor(s). Upon completion of the electronic security hardware installation, verify that all components are working properly and state in the required guarantee that this inspection has been performed.
- G. Wiring Diagrams: Provide complete wiring diagrams for each opening requiring electrified hardware, except openings where only magnetic hold-opens are specified. Provide a copy with each hardware schedule submitted after approval. Supply a copy with delivery of hardware to job site and another copy to owner at time of job completion.
- H. Doors and Frames used in positive pressure opening assemblies shall meet UL10C in areas where this specification includes Seals for smoke door.

1.06 QUALITY ASSURANCE

- A. Hardware supplier to be a qualified, Factory Authorized, direct distributor of the products to be furnished. In addition, the supplier to have in their regular employment an A.H.C. or person of equivalent experience who will be made available at reasonable times to consult with the Architect/Contractor and/or Owner regarding any matters affecting the finish hardware on this project.
- B. All hardware used in labeled fire or smoke rated openings to be listed for those types of openings and bear the identifying label or mark indicating UL. (Underwriter's Laboratories) approved for fire. Exit devices in non-labeled openings to be listed for panic.

1.07 DELIVERY, HANDLING AND PACKAGE

- A. Furnish all hardware with each unit clearly marked and numbered in accordance with the hardware schedule. Include door and item number for each.
- B. Pack each item of hardware completes with all necessary parts and fasteners.
- C. Properly wrap and cushion each item to prevent scratches and dents during delivery and storage.

1.08 SEQUENCING AND SCHEDULING

Any part of the finish hardware required by the frame or door manufacturers or other suppliers that is needed to produce doors or frames is to be sent to those suppliers in a timely manner, so as not to interrupt job progress.

1.09 WARRANTY

All finish hardware shall be supplied with a Two- (2) year warranty against defects in materials and workmanship, commencing with substantial completion of the project except as follows:

- 1. All Closers to have a thirty- (30) year written warranty.
- 2. All Exit Devices to have a three- (3) year written warranty.
- 3. All Grade 1 Locksets to have a ten- (10) year written warranty.
- 4. All Continuous Hinges to have a life of installation written warranty.

PART 2 PRODUCTS

2.01 FASTENERS

- A. Furnish with finish hardware all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for a long life under hard use.
- B. Furnish fastenings where necessary with expansion shields, toggle bolts and other anchors designated by the Architect according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer. All closers and exit devices on labeled wood doors shall be through-bolted if required by the door manufacturer. All thresholds shall be fastened with machine screws and anchors. Where specified in the hardware sets, security type fasteners of the type called for are to be supplied.
- C. Design of all fastenings shall harmonize with the hardware as to material and finish.
- D. All hardware shall be installed with the Manufacturers standard screws as provided. Use of any other type of fasteners shall not be permitted.

2.02 ENVIRONMENTAL CONCERN FOR PACKAGING

Hardware shipped to the project job site shall be packaged in biodegradable packs such as paper or cardboard boxes and wrapping.

2.03 HINGES

- A. All hinges to be of one manufacturer as hereafter listed for continuity and consideration of warranty. Provide one of the following manufacturers Select, Hager, Ives or Stanley.
- B. Unless otherwise specified provide five-knuckle, heavy-duty, ball-bearing, button tip, full mortise template type hinges with non-rising loose pins. Provide non-removable pins for out swinging doors at secured areas or as called for in this specification (Reference 3.02 Hardware Sets).
- C. Exterior Door Hinges
 - 1. Provide out-swinging door hinges of solid bronze, steel, aluminum or stainless steel with non-removable pins or security studs as called for in this specification (Reference 3.02 hardware sets).
- D. Interior Door Hinges
 - 1. Stainless steel or steel polished and/or plated to match specified finish shall be provided. Furnish three (3) hinges up to 90 inches high and one (1) additional hinge for every 30 inches or fraction thereof unless otherwise specified in 3.02 Hardware Sets.
- E. Provide size 4½" x 4½" for all 1¾" thick doors up to and including 36 inches wide (1 1/2 pairs). Doors over 1¾" through 2¼" thick, use 5" x 5" hinges. Doors over 36 inches use 4 1/2" x 4 1/2" (2 pair) unless otherwise specified in 3.02 Hardware Sets.
- F. Where required to clear the trim and/or to permit the doors to swing 180 degrees furnish hinges of sufficient throw.
- G. Provide heavy weight hinges on all doors over 36 inches in width.

- H. At labeled door's steel or stainless steel, ball-bearing-type hinges shall be provided. For all doors equipped with closers provide ball-bearing-type hinges.
- I. Finishes
 - 1. At wood doors, hinges are to be plated to match adjacent hardware or as called for in 3.02 Hardware Sets.
 - 2. At hollow metal doors, hinges are to be aluminum or stainless steel at exterior out-swinging doors, unless otherwise specified in 3.02 Hardware Sets.
- J. Continuous hinges shall be as specified.

2.04 LOCK AND LOCK TRIM

- A. All locksets, latch sets, and trim to be of one manufacturer as hereafter listed for continuity of design and consideration of warranty. Locks, passage, and privacy sets shall be the product of Schlage Lock Co., "ND" Vandlgard series with Rhode's lever (No Substitutions). All locks, passage and privacy sets are to be provided in a dull chrome (626) finish. All locks and cylinders shall be prepared for large format Schlage interchangeable cores in the key section required by Alamo College District. Verify the key section with the Alamo College District locksmith prior to fabrication or ordering.
- B. Provide metal wrought box strike boxes and curved lip strikes with proper lip length to protect trim of the frame, but not to project more than 1/8 inch beyond frame trim or the inactive leaf of a pair of doors. All pairs of doors shall have a 3/4" latch projection.
- C. Mechanical Locks shall meet ANSI Operational Grade 1, Series 4000 as specified in 3.02 Hardware Sets.
 - 1. Hand of lock is to be easily reversible in the field or non-handed.
 - 2. All lever trim is to be through-bolted through the door.
 - 3. All pairs of doors shall be provided with a 3/4" latch throw or projection.
 - 4. All locks shall have the ability to be field repaired and lock function changed without the purchase of a new locking device.

2.05 PERMANENT CYLINDERS, KEYING AND ACCEPTABLE SUPPLIERS

- A. The hardware supplier shall provide locks and Exit devices requiring cylinders prepared for Schlage large format interchangeable core 6 pin key System and comply with performance requirements of ANSI A156.5. All keys shall be manufactured of nickel silver material only. All exterior and interior locks shall be supplied with keyed construction cores for the duration of the construction period by the hardware supplier. Construction cores are to be returned to the hardware supplier no later than thirty (30) days after the installation of permanent cores. The hardware supplier shall provide ten- (10) construction keys and two- (2) construction control keys total (No Substitutions Allowed).
- B. All permanent cores shall be keyed to the existing Master Key System as instructed by the Alamo College Representative at an onsite keying meeting coordinated by the general contractor. Provide and deliver all permanent cores and keys directly to the Alamo College District (signature required for proof of delivery). The General Contractor and Alamo College District shall install all permanent cores and return all the construction cores to the general contractor (Verify Keyway required prior to fabrication with Alamo College District). Provide four (4) keys per permanent core and six (6) master keys per master set used. Stamp all keys, "Do Not Duplicate" and with key symbol as instructed by Alamo College District.

2.06 EXIT DEVICES

- A. All exit devices and trim, including electrified items, to be of one manufacturer as hereafter listed and in the hardware sets for continuity of design and consideration of warranty.
- B. Exit Devices to be "UL" listed for life safety. All exit devices for labeled doors shall have "UL" label for "Fire Exit Hardware". All devices mounted on labeled wood doors are to be through-bolted or per the manufacturer's listing requirements. All devices shall conform to NFPA 80 and NFPA 101 requirements.
- C. All exit devices to be of a heavy duty, chassis mounted design, with one-piece removable covers, eliminating necessity of removing the device from the door for standard maintenance and keying requirements.
- D. All trims to be through-bolted to the lock stile case. Lever design to be the same as specified with the lock sets (#06/Rhodes).
- E. Exit Devices to be the modern push rail design. Finish shall be satin aluminum (628).
- F. All devices shall carry a three- (3) year warranty against manufacturing defects and workmanship.
- G. Exit Devices shall be convertible in the field to accept electrified operations without purchasing completely new exit devices.
- H. Exit Devices shall be Von Duprin "33A & 99" series as specified (No Substitution).

2.07 SURFACE-MOUNTED DOOR CLOSERS

- A. All closers for this project shall be the products of a single manufacturer for continuity of design and consideration of warranty. All door closers shall be mounted as to achieve the maximum degree of opening (trim permitting).
- B. All closers to be heavy duty, surface-mounted, fully hydraulic, rack and pinion action with high strength cast iron cylinder to provide control throughout the entire door opening cycle. All closers shall have been tested and passed a ten million-cycle test.
- C. Size all closers in accordance with the manufacturer's recommendations at the factory.
- D. All closers to have adjustable spring power sizes 1 through 4 or 6 as specified and separate tamper resistant, brass, non-critical regulating screw valves for closing speed, latching speed and back-check control as a standard feature unless specified otherwise.
- E. All closer covers to be rectangular, full cover type of non-ferrous, non-corrosive material painted to match closer.
- F. Closer to have heavy-duty arms. All closer arms shall be of sufficient length to accommodate the reveal depth and to insure proper installation
- G. Supply appropriate arm assembly for each closer so that closer body and arm are mounted on non-public side of door opening and on the interior side of exterior openings, except where required otherwise in the hardware sets.
 - 1. All parallel arm mounted closers to be factory indexed to insure proper installation.

2. Furnish heavy-duty cold forged parallel arms for all parallel arm mounted closers.
- H. Provide closers with special application and heavy-duty arms as specified in the hardware sets or as otherwise called for to insure a proper operating, long lasting opening.
- I. Finish: Sprayed enamel finish shall match other hardware.
- J. Closers shall be LCN 4040XP as specified (**No Substitutions**).

2.08 AUTOMATIC DOOR OPENERS

- A. All automatic door openers shall be LCN 9500 Series as shown below:
 1. LCN #9531 STD - Single (Pull Side Mount)
 2. LCN #9542 REG - Single (Push Side Mount)
 3. LCN #9553 REG2 - Double (Push Side Mount) simultaneous
 4. LCN #9553 STD2 - Double (Pull Side Mount) simultaneous
- B. Provide two (2) each Hard-Wired Actuators & Mounting Boxes (8310-853T x 8310-867F or 8310 867S) 4.5" diameter engraved with handicapped logo & push-to-open for each Automatic Operator listed in 3.2 Hardware Sets. Provide Weather Ring 8310-801 for all exterior mounted Actuator's. Provide key operated "On/Off" switches #8310-806K at all Automatic operators. Provide Mullion Mounted Actuator if required and requested in lieu of the 8310-853T listed above.

2.09 DOOR STOPS AND HOLDERS

- A. Door stops are to be furnished for every door leaf. Every door is to have a floor, wall, or an overhead stop.
- B. Place doorstops in such a position that they permit maximum door swing, but do not present a hazard of obstruction. Furnish floor strikes for floor holders of proper height to engage holders of doors. The contractor shall place wood blocking in all stud walls specified and scheduled to receive wall stops.
- C. Where overhead stops and holders are specified, or otherwise required for proper door operation, they are to be heavy duty and of extruded brass, bronze or stainless steel with no plastic parts as specified.
- D. Finish: Same as other hardware where available.
- E. Acceptable Products
 1. Floor and wall stops as listed in hardware sets. Equivalent products as manufactured by Ives, Rockwood and Trimco are acceptable.

2.10 PUSH PLATES, DOOR PULLS, AND KICKPLATES

- A. All push plates, door pulls, kick plates and other miscellaneous hardware as listed in hardware sets. Equivalent products as manufactured by Ives, Rockwood and Trimco are acceptable.
- B. Kick plates to be 10 inches high and Mop plates to be 6 inches high, both by 2 inches or 1 inch less than door width (LDW) as specified. They are to be of 16 gauge (.050 inches)

thick stainless steel. For door with louvers or narrow bottom rails, kick plate height to be 1 inch less dimension shown from the bottom of the door to the bottom of the louver or glass.

- C. Where required armor plates, edge guards and other protective hardware shall be supplied in sizes as scheduled in the hardware sets.
- D. Finish: Same as other hardware where available.

2.11 FLUSH BOLTS AND COORDINATORS

- A. Provide Flush bolts with Dust Proof Strikes as indicated in the individual hardware sets by Ives, Rockwood and Trimco are acceptable. Finish shall match adjacent hardware.
- B. Provide and install only at locations approved by code.

2.12 THRESHOLDS AND SEALS

- A. Provide materials and finishes as listed in hardware sets and manufactured by Zero. Equivalent product by National Guard Products and Pemko are acceptable if proven to be equal to products specified. All thresholds must be in accordance with the requirements of the ADA and ANSI A117.1.
- B. Provide thresholds with stainless steel sleeve anchors #226 and full body strength fill "V3" without exception. Supply all necessary anchoring devices for weather strip and sound seal.
- C. Seals shall comply with requirements of UL10C. All thresholds, door bottoms and weather stripping shall be provided with silicone inserts as specified in 3.02 Hardware Sets.
- D. Seals shall comply with the requirements of the Wood Door Manufacturer's certification requirements.

2.13 KEYED REMOVABLE MULLIONS

- A. Keyed removable mullions shall be Von Duprin KR4954 & KR9954 type with FSIC mortise cylinders. Finish shall be sprayed aluminum (SP28). Provide one (1) Mullion Storage Bracket MT54 and 154 Stabilizers with every mullion supplied (No Substitutions).

2.14 FINISHES

- A. Finishes for all hardware are as required in this specification and the hardware sets.
- B. Special care is to be taken to make uniform the finish of all various manufactured items.

2.15 DOOR SILENCERS AND KEY CABINET

- A. Provide door silencers at all openings without gasket. Provide two- (2) each at each pair of doors and three (3) or four- (4) each for each single door (coordinate with the frame manufacturer).
- B. Provide a Lund key cabinet #1200 for installation by the contractor as instructed by the Architect and ACD. Key cabinet shall be of such size as to hold 100% of the total number of keys supplied, plus 100% expansion. If requested by ACD the hardware supplier shall (On the Project Site) assist and train the owner's staff in the proper use of the key cabinet. This shall include the tagging of all keys, instructing the ACD staff as to the proper use of

the key cabinet and how they can best maintain the key system. The hardware supplier shall send the Architect written confirmation that this has been completed. Confirmation shall include the date training occurred and names of all staff members trained.

2.16 PROPRIETARY PRODUCTS

- A. References to specific products are used to establish quality standards of utility and performance. Unless otherwise approved provide only the specified product.
- B. All other materials, not specifically described, but required for a complete and proper finish hardware installation, are to be selected by the Contractor, subject to the approval of the Architect and Alamo College District.
- C. Architect and Alamo College District reserve the right to approve all the substitutions proposed for this specification. All requests for substitution to be made prior to bid in accordance with Division 1, General Requirements, and are to be in writing, hand delivered to the Architect. Two (2) copies of the manufacturer's brochures and a physical sample of each item in the appropriate design and finish shall accompany requests for substitution.

PART 3 EXECUTION OF AND/OR INSTALLATION

3.01 INSTALLATION OF FINISH HARDWARE

- A. All finish hardware shall be installed by the finish hardware supplier with at least ten (10) years of experience after a pre-installation meeting between the contractor, electrical contractor, hardware Manufacturers representative, the hardware supplier, the hollow metal supplier and the wood door supplier. The finish hardware supplier/installer shall be responsible for the proper installation and function of all doors and hardware. Installation shall include wiring all electrified products (Including the required wire) to the power supply and/or junction box.
- B. Check hardware against the reviewed hardware schedule upon delivery. Store the hardware in a dry and secure location to protect against loss and damage.
- C. Install finish hardware in accordance with approved hardware schedule and manufacturers' printed instructions. Pre-fit hardware before finish is applied to door; remove and reinstall after finish is complete and dry. Install and adjust hardware so that parts operate smoothly, close tightly, and do not rattle.
- D. Mortise and cutting to be done neatly, and evidence of cutting to be concealed in the finished work. Protect all Finish hardware from scratching or other damage.

3.02 HARDWARE SETS

Hardware Group No. 001

For use on Door #(s):

159 166A 167 167E

Provide each RU door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	MORTISE CYLINDER	20-059 (CAM AS REQ)	626	SCH
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
		REMAINING HARDWARE	PROVIDED BY THE OH DOOR MFG.		

Hardware Group No. 101

For use on Door #(s):

170

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8 CON	652	IVE
1	EA	ELEC CLASSROOM LOCK	AD-300-CY-70-MT-RHO-JD-CON (PROVIDED BY DIV 28)	626	SCE
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 201

For use on Door #(s):

166B 167C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL STOREROOM LOCK	ND96TD RHO	626	SCH
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 203

For use on Door #(s):
 175

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL STOREROOM LOCK	ND96TD RHO	626	SCH
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 212S

For use on Door #(s):
 173

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
5	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 CON TW8	652	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	ELEC CLASSROOM LOCK	AD-300-CY-70-MT-RHO-JD-CON (PROVIDED BY DIV 28)	626	SCE
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	COORDINATOR	3780	689	ABH
1	EA	OH STOP	100S 90-DEGREE	630	GLY
1	EA	SURFACE CLOSER	4040XP SCUSH - 4040XP 18PA - 4040XP 130 RHR LEAF ONLY	689	LCN
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER ALUM FRAME ONLY		
1	EA	STRIKE ASTRAGAL	43SP-DOOR HEIGHT	SP	ZER
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 341

For use on Door #(s):

167B1 171A 172A 174

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC	626	SCH
1	EA	SURFACE CLOSER	4040XP H TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 501

For use on Door #(s):

262

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94TD RHO	613	SCH
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 501G

For use on Door #(s):

264

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	VANDL CLASSROOM LOCK	ND94TD RHO	613	SCH
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	WALL STOP	WS406/407CCV	630	IVE
		REMAINING HARDWARE	PROVIDED BY STC DOOR MFG.		

Hardware Group No. 503SW

For use on Door #(s):
 167A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 5 X 4.5 NRP	652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94TD RHO	613	SCH
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	OH STOP	100S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 503W

For use on Door #(s):
 167B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94TD RHO	613	SCH
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 507

For use on Door #(s):
 263

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94TD RHO	613	SCH
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 800G

For use on Door #(s):
 157.4B 159E 159F 159G

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	DUMMY PUSH BAR	330 LENGTH AS REQ	626	VON
1	EA	DOOR PULL	VR910 DT	630	IVE
2	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
2	EA	WALL STOP	WS406/407CCV	630	IVE
		REMAINING HARDWARE	PROVIDED BY STC DOOR MFG.		

Hardware Group No. 801

For use on Door #(s):

158A 158B 171 172

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8302 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. C201

For use on Door #(s):

163

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8 CON	652	IVE
1	EA	ELEC CLASSROOM LOCK	AD-300-CY-70-MT-RHO-JD-CON (PROVIDED BY DIV 28)	626	SCE
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. C201C

For use on Door #(s):

160 164 165

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8 CON	652	IVE
1	EA	ELEC CLASSROOM LOCK	AD-300-CY-70-MT-RHO-JD-CON (PROVIDED BY DIV 28)	626	SCE
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH - 4040XP 18PA - 4040XP 130	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. C201CG

For use on Door #(s):
 167B5

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ELEC CLASSROOM LOCK	AD-300-CY-70-MT-RHO-JD-CON (PROVIDED BY DIV 28)	626	SCE
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH - 4040XP 18PA - 4040XP 130	689	LCN
		REMAINING HARDWARE	PROVIDED BY STC DOOR MFG.		

Hardware Group No. C205

For use on Door #(s):
 169

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8 CON	652	IVE
1	EA	VANDL EU STOREROOM	ND96TDEU RHO RX CON 12V/24V DC	626	SCH
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH - 4040XP 18PA - 4040XP 130	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	328AA (2PCS JAMB HEIGHT)	AA	ZER
1	EA	GASKETING	429AA (1PC HEADER WIDTH)	AA	ZER
1	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	65A-V3-226	A	ZER
1	EA	MULTITECH READER	MT15 OR TYPE PROVIDED BY SECURITY CONTRACTOR	BLK	SCE

Hardware Group No. C710CGM

For use on Door #(s):

159A 159B 159C 159D

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954B-STAB-MT54 8'6"	SP28	VON
1	EA	ELEC PANIC HARDWARE	SD-RX-QEL-99-EO 24 VDC	628	VON
1	EA	ELEC PANIC HARDWARE	SD-RX-QEL-99-NL-OP-110MD 24 VDC	628	VON
4	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
4		CYLINDER	AS REQUIRED	626	SCH
1	EA	DOOR PULL	VR910 DT	630	IVE
1	EA	DOOR PULL	VR910 NL	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH - 4040XP 18PA - 4040XP 130	689	LCN
4	EA	HARNES (1 IN DOOR & 1 IN FRAME - EACH LEAF)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	MULTITECH READER	MT15 OR TYPE PROVIDED BY SECURITY CONTRACTOR	BLK	SCE
1	EA	POWER SUPPLY	PROVIDED BY SECURITY PROVIDER		
2	EA	DOOR CONTACT	679-05 (OR TYPE SUPPLIED BY SECURITY CONTRACTOR)	BLK	SCE
		REMAINING HARDWARE	PROVIDED BY STC DOOR MFG.		

Hardware Group No. C711C

For use on Door #(s):

161 167D 167F 168

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 TW8 CON	652	IVE
1	EA	PANIC HARDWARE	99-EO LENGTH AS REQ	626	VON
1	EA	ELEC EXIT DEVICE TRIM	AD-300-993R-70-MT-RHO-J-RHR 12/24 VDC	626	SCE
1	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH - 4040XP 18PA - 4040XP 130	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. C714AM

For use on Door #(s):

155A 155B 156B 157 158

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT HEIGHT AS REQ	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954B-STAB-MT54 8'6"	SP28	VON
1	EA	ELEC PANIC HARDWARE	SD-RX-QEL-99-EO 24 VDC	628	VON
1	EA	ELEC PANIC HARDWARE	SD-RX-QEL-99-NL-OP-110MD 24 VDC	628	VON
1	EA	RIM CYLINDER	20-057 ICX W/KEYED CONST. CORE	626	SCH
3	EA	MORTISE CYLINDER HOUSING	20-059 - FSIC X KEYED CONSTRUCTION CORE; CAM AS REQ FOR SD DOGGING/MULLION	626	SCH
4	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
1	EA	DOOR PULL	VR910 DT	630	IVE
1	EA	DOOR PULL	VR910 NL	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH - 4040XP 18PA - 4040XP 130	689	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	SET	SEAL	PERIMETER SEAL BY FRAME MANUFACTURER		
1	SET	ASTRAGAL	MEETING STILE SEAL BY DOOR MANUFACTURER		
2	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
1	EA	THRESHOLD	65A-V3-226	A	ZER
4	EA	HARNES (1 IN DOOR & 1 IN FRAME - EACH LEAF)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	MULTITECH READER	MT15 OR TYPE PROVIDED BY SECURITY CONTRACTOR	BLK	SCE
1	EA	POWER SUPPLY	PROVIDED BY SECURITY PROVIDER		
2	EA	DOOR CONTACT	679-05 (OR TYPE SUPPLIED BY SECURITY CONTRACTOR)	BLK	SCE

Hardware Group No. C714M

For use on Door #(s):

160A 167.16

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT HEIGHT AS REQ	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954B-STAB-MT54 8'6"	SP28	VON
1	EA	ELEC PANIC HARDWARE	SD-RX-QEL-99-EO 24 VDC	628	VON
1	EA	ELEC PANIC HARDWARE	SD-RX-QEL-99-NL-OP-110MD 24 VDC	628	VON
4	EA	FSIC CORE	23-030 KEYWAY AS REQD	626	SCH
4		CYLINDER	AS REQUIRED	626	SCH
1	EA	DOOR PULL	VR910 DT	630	IVE
1	EA	DOOR PULL	VR910 NL	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH MC ST-1595 SPEC	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	328AA (2PCS JAMB HEIGHT)	AA	ZER
1	EA	GASKETING	429AA (1PC HEADER WIDTH)	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A-DOOR WIDTH	A	ZER
2	EA	MEETING STILE	8194 (2PCS AT MEETING STILE) HEIGHT REQD	AA	ZER
1	EA	THRESHOLD	65A-V3-226	A	ZER
2	EA	HARNESS (1 IN DOOR & 1 IN FRAME - EACH LEAF)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	MULTITECH READER	MT15 OR TYPE PROVIDED BY SECURITY CONTRACTOR	BLK	SCE
1	EA	POWER SUPPLY	PROVIDED BY SECURITY PROVIDER		
2	EA	DOOR CONTACT	679-05 (OR TYPE SUPPLIED BY SECURITY CONTRACTOR)	BLK	SCE

END OF SECTION

SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Float Glass (GG).
 - 2. Tempered Glass (GT).
 - 3. Spandrel Glass (GS).
 - 4. Insulated Glass (GI).
 - 5. Laminated Safety Glazing (GL).
 - 6. Fire Resistant Glazing (GF).
 - 7. Glazing Sealants.
 - 8. Glass Film Overlay.
 - 9. Accessories necessary for a complete installation.

1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- D. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- E. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- G. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
- H. {RSTEMP#623}
- I. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
- J. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- K. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- L. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials; 2019.
- M. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2023.
- N. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- P. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- Q. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies; 2017.

- R. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
- S. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2020.
- T. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2017.
- U. UL 9 - Standard for Fire Tests of Window Assemblies; Current Edition, Including All Revisions.
- V. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.4 DEFINITIONS

- A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C1036.
- B. Interspace: Space between lites of an insulating glass unit.

1.5 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass panels including comprehensive engineering analysis by a qualified professional engineer lawfully licensed in the State of Texas, using performance requirements and design criteria indicated.
- B. Installed Glazing: Design glazing systems to withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E1300.
 - 1. Design Wind Pressures: As indicated on Structural Drawings.
 - 2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - a. Wind Design Data: As indicated on Structural Drawings.
 - b. Basic Wind Speed: As indicated on Structural Drawings.
 - c. Importance Factor: As indicated on Structural Drawings.
 - 3. Exposure Category: As indicated on Structural Drawings.
 - 4. Design Snow Loads: As indicated on Structural Drawings.
 - 5. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
 - 6. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
 - 7. Maximum Lateral Deflection: For glass supported on all four edges, limit center of glass deflection at design wind pressure to not more than 1/50 times the short side length or 1 inch (25 mm), whichever is less.
- D. Windborne Debris Impact Resistance: Exterior glazing shall comply with -protection testing requirements in ASTM E1996 for when tested according to ASTM E1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.
 - 1. Large Missile Test: For glazing located within 30 feet (9.1 m) of grade
 - 2. Small Missile Test: For glazing located more than 30 feet (9.1 m) above grade
- E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II
- F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic glass lites, properties are based on units with lites 6 mm thick.
2. For laminated glass lites, properties are based on products of construction indicated.
3. For insulating glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center of glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. Solar Heat Gain Coefficient and Visible Transmittance: Center of glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

1.6 SUBMITTALS

- A. Product Data: Technical data for each type of product including recommended installation and cleaning procedures.
- B. Glass Samples: For each type of glass required. Prepare samples from same material to be used for Work.
- C. Glazing Schedule: List glass types and thickness for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Certificates: Submit glass product certificates required by Code.
 1. Glass Manufacturer Certificate: The glass manufacturer shall submit a letter certifying it has reviewed the glazing details proposed for the project, including the use of gaskets and sealants, and that each product furnished is recommended for the application shown and compliance with the Code.
- F. Thermal Stress and Wind Load Analyses: Submit the following from the glass manufacturer:
 1. Thermal stress analysis for each exterior glass unit type, each building elevation. The analysis shall clearly indicate the expected service temperature ranges and the effects of partial and full shading on the glass.
 - a. Attach to the thermal stress analysis a statement from the glass manufacturer that based upon this analysis that the resulting thermal stresses will not reduce the specified statistical probability of breakage.
 2. Wind load analysis for each glass unit type, each building elevation. The analysis shall indicate the statistical probability of breakage at the design wind pressure does not exceed the specified statistical probability of breakage.
- G. Product Test Reports: Submit test reports for insulating glass and glazing sealants, for tests performed by a qualified testing agency.
 1. Glazing Sealants: Provide test reports based on testing current sealant formulations within previous 36 month period.
 2. Glazing Sealants: Preconstruction adhesion and compatibility test report.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Building Code: Comply with applicable requirements of the IBC for glazing.
 2. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
 - a. As a minimum provide Category II materials complying with testing requirements in 16 CFR 1201 (Consumer Product Safety Commission Safety Standard for Architectural Glazing Materials, published in the Code of Federal Regulations) and ANSI Z97.1.

- b. Permanently mark safety glass with certification label of Safety Glazing Certification Council.
 3. Insulating Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
 4. Glazing Publications: Comply with published recommendations of glass product organizations
 - a. GANA: Glazing Manual.
 - b. IGMA: SIGMA TM-3000 Vertical Glazing Guidelines.
 - c. GANA: Laminated Glazing Reference Manual.
 - d. AAMA: AAMA GDSG-1 Glass Design for Sloped Glazing.
 - e. AAMA: TIR A7 Sloped Glazing Guidelines.
 - f. IGMA for Sloped Glazing: IGMA TB-3001 Guidelines for Sloped Glazing.
 - g. IGMA for Insulating Glass: SIGMA TM-3000 North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use.
 5. Fire Rated Door Assemblies: Assemblies complying with NFPA 80 listed and labeled by UL for fire ratings indicated, based on testing according to NFPA 252.
 6. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
 - a. Minimum Glass Thickness for Exterior Lites: 6 mm.
 - b. Thickness of Tinted Glass: Provide same thickness for each tint color indicated.
 7. Strength: Where annealed float glass is indicated, provide annealed float glass, heat strengthened float glass, or fully tempered float glass necessary to comply with performance requirements.
 - a. Where heat strengthened float glass is indicated, provide heat strengthened float glass or fully tempered float glass necessary to comply with performance requirements.
 - b. Where fully tempered float glass is indicated, provide fully tempered float glass.
- B. Manufacturer Qualifications for Insulating Glass Units with Sputter Coated, Low E Coatings: Insulating glass manufacturer who is approved and certified by coated glass manufacturer.
- C. Installer Qualifications, Glazer: Experience entity having minimum 5 years documented experience and who employs glass installers certified under the National Glass Association's Certified Glass Installer Program.
- D. Installer Qualifications, Decorative Film: Experience entity having minimum 5 years documented experience in the installation of glass films.
- E. Source Limitations for Glass and Glass Accessories: Obtain each type of glass and glass accessories from a single source.
- F. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- G. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
- H. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
- I. Install glazing in mockups specified in to match glazing systems required for Project, including glazing methods.
 1. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.
- J. Pre-Construction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

K. Pre-Installation Conference: Conduct conference at site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by manufacturer.
- D. Exercise exceptional care to prevent edge damage to glass, and damage/deterioration to coating on glass.
- E. Comply with insulating glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 degrees F (4.4 degrees C).
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.10 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.11 WARRANTY

- A. Coated Glass Products: Written warranty signed by manufacturer in which glass manufacturer agrees to replace coated glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 1. Warranty Period: Ten (10) years from date of Substantial Completion
- B. Laminated Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace laminated glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision

through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: Ten (10) years from date of Substantial Completion.
- C. Insulating Glass: Written warranty signed by manufacturer in which manufacturer agrees to replace insulating glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
1. Warranty Period: Ten (10) years from date of Substantial Completion.
- D. Glass Film: Written warranty signed by glass film manufacturer and installer in which manufacturer and installer agree to replace glass film that crack, peel, delaminate, discolor, change appearance, or failure to meet solar criteria within specified warranty period.
1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 ACCEPTABLE FABRICATORS:

- A. Manufacturer-certified fabricators.

2.3 MATERIALS

- A. Clear, Annealed, Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.
- C. Fully-Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
1. Fabrication Process: By horizontal (roller hearth) process with roll wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Glass Film Overlay: Translucent, dimensionally stable, cast PVC film, 2 mil (0.05 mm) minimum thickness, with pressure sensitive, clear adhesive back for adhering to glass and releasable protective backing.

2.4 FIRE RESISTANT GLAZING

- A. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire protection ratings indicated, based on positive pressure testing according to NFPA 257 or UL 9, including the hose stream test, and complying with NFPA 80. For ratings 60 minutes or greater, glazing shall meet the test requirements of ASTM E119 or UL 263.
- B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire protection rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction indicating manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 degrees F (250 degrees C) temperature rise limitation; and the fire resistance rating in minutes.
- C. Film Faced Ceramic Glazing: Clear, ceramic flat glass; 5 mm thickness; faced on one surface with a clear glazing film; and complying with 16 CFR 1201, Category II.

2.5 INSULATING GLAZING UNITS

- A. Insulating Glazing Units: Factory assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.
- B. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.

1. Spacer: Aluminum with black, color anodic finish. Thermally broken aluminum
 2. Desiccant: Molecular sieve or silica gel, or a blend of both.
 3. Performance Properties: Refer to Glazing schedule.
- C. Spandrel Glass:
1. Silicone Coated Spandrel Glass: ASTM C1048, Type I, Condition C, Quality-Q3.
 2. Fallout Resistance: Provide spandrel units identical to those passing fallout resistance test for spandrel glass specified in ASTM C1048.

2.6 LAMINATED GLAZING

- A. Laminated Glass: {RS#623}. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
1. Construction: Laminate glass with polyvinyl butyral interlayer, ionomeric polymer interlayer, or cast in place and cured transparent resin interlayer, as scheduled, to comply with interlayer manufacturer's written instructions.
 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 3. Interlayer Thickness: As required.
 4. Interlayer Color: Clear unless otherwise indicated
- B. Windborne Debris Impact Resistant Laminated Glass: Comply with requirements for laminated glass except laminate glass with ionomeric polymer interlayer to comply with interlayer manufacturer's written instructions:

2.7 GLASS FILM

- A. Performance Requirements:
1. Scratch resistant coating that, after fully cured, facilitates cleaning without damaging or scratching film.
 2. Optical Distortion: When viewed from a distance of 10 feet at angles up to 45 degrees from either side of the glass, there is no discernible distortion.
 3. Edges: Seal edges except when the film is applied with a lacquer that prevents moisture or free water from penetrating between the film and the glass.
- B. Coating: Provide coating with uniform finish, without noticeable pin holes, streaks, thin spots, scratches, or banding.
1. Light Transmission:
 - a. Maximum Variation across Width and Length: Not to exceed 1 percent.
 - b. Variation in Transmission across Width and Length: Not to exceed 2 percent.
- C. Rate of Change of Total Transmission across Width and Length: Not to exceed 1 percent in 4 inches.

2.8 GLAZING ACCESSORIES

- A. Compatibility: Provide glazing sealants compatible with one another and with other materials in contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of service and application, demonstrated by sealant manufacturer based on testing and field experience.
- B. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- C. Colors of Exposed Glazing Sealants: As selected by Architect.
- D. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.

- b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - d. Pecora Corporation.
 - e. Sika Corporation.
- E. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Dow Corning Corporation.
 - c. GE Construction Sealants; Momentive Performance Materials Inc.
 - d. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - e. Pecora Corporation.
 - f. Polymeric Systems, Inc.
 - g. Sika Corporation.
- F. Glazing Sealant: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik, Inc.
 - b. Dow Corning Corporation.
 - c. GE Construction Sealants; Momentive Performance Materials Inc.
 - d. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - e. Polymeric Systems, Inc.
 - f. Schnee-Morehead, Inc., an ITW company.
 - g. Sika Corporation.
- G. Glazing Sealant: Acid curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Bostik, Inc.
 - c. Dow Corning Corporation.
 - d. GE Construction Sealants; Momentive Performance Materials Inc.
 - e. May National Associates, Inc.; a subsidiary of Sika Corporation.
 - f. Pecora Corporation.
 - g. Polymeric Systems, Inc.
 - h. Schnee-Morehead, Inc., an ITW company.
 - i. Sika Corporation.
- H. Glazing Sealants for Fire-Resistance-Rated Glazing Products: Neutral curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - 2. Colors of Exposed Glazing Sealants: As selected by Architect.
- I. Back Bedding Mastic Glazing Tapes: Preformed, butyl based, 100 percent solids elastomeric tape; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod recommended in writing by tape and glass manufacturers for application indicated; and

complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- J. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
- K. Miscellaneous Glazing Accessories: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with proven record of compatibility with surfaces contacted in installation.
1. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
 2. Setting Blocks: Silicone, minimum 4 inches long and wide enough to fully support all lites of glazing unit.
 3. Spacers: Silicone blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 4. Edge Blocks: Silicone material of hardness needed to limit glass lateral movement (side walking).
 5. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
 6. Perimeter Insulation for Fire Resistant Glazing: Product approved by testing agency listed and labeled fire resistant glazing product with which it is used for application and fire protection rating indicated.

2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.
 2. Edge and Surface Conditions: Comply with the recommendations of AAMA Structural Properties of Glass for clean cut edges, except comply with manufacturer's recommendations.
 3. Exposed Glass Edges and Surface Condition: Finish edges flat with an arrissed edge profile (small bevel of uniform width not exceeding 1.5 mm at an angle of approximately 45 degrees to the surface of the glass) with polished (surface is reflective in appearance similar to the major surface of the glass) surface.
- B. Cutting: Wheel cut or sawed edges and seamed at manufacturer's option. For site cut glass, provide glass 2 inches (50.8 mm) larger than required in both dimensions to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat treated glass.
- C. Butt Glazing: Clean cut or flat grind vertical edges of butt glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
1. Edges: Grind smooth and polish exposed glass edges and corners.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation after correcting unsatisfactory conditions.

3.2 PREPARATION

- A. Clean glazing channels and framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
 - 1. Comply with manufacturer instructions for wiping of surfaces immediately before application of primers.
 - 2. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.
- B. Inspect each piece of glass immediately before installation. Do not install pieces improperly sized or with damaged edges, scratches, abrasion, or evidence damage. Remove labels from glass immediately after installation.
- C. Examine glazing units to locate exterior and interior surfaces. Label or mark units so exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.
- D. Seal vent (breather or capillary) tubes in insulating glass units in accordance with insulating glass manufacturer written recommendations.
- E. Glass Film Preparation:
 - 1. Remove particulate matter on the glass surface using a scraping blade.
 - 2. Place an absorbent towel on window sill or sash to absorb moisture generated by the film application.

3.3 GLAZING

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8 inch (3 mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
 1. Square cut wedge shaped gaskets at corners and install gaskets as recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- K. Tape Glazing: Position tapes on fixed stops so that, when compressed by glass, the exposed edges are flush with or protrude slightly above sightline of stops.
 1. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make tapes fit opening.
 2. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
 3. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
 4. Do not remove release paper from tape until right before each glazing unit is installed.
 5. Apply heel bead of elastomeric sealant.
 6. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
 7. Apply cap bead of elastomeric sealant over exposed edge of tape.
- L. Gasket Glazing (Dry): Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
 1. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
 2. Installation with Drive in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
 3. Installation with Pressure Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
 4. Install gaskets to protrude past face of glazing stops.
- M. Sealant Glazing (Wet): Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

1. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
 2. Tool exposed surfaces of sealants to provide a substantial wash away from glass.
- N. Structurally Glazed Units: Set full height continuous structural gaskets/spacers to vertical mullions. Set glass units with void between edge of units and head/sill channel, but with units fully within head/sill rebate so as to provide a proper bite.
1. Align glass unit edges over vertical mullion continuous structural gasket/spacers and secure with manufacturers recommended temporary cleats.
 2. Structurally seal glass unit to vertical mullions with specified one part structural silicone sealant. Tool structural silicone flush in alignment to mullion face and perpendicular to face of interior glass light; remove excess structural silicone from glass and metal substrates.
 3. After full cure of structural silicone sealant remove temporary cleats. Immediately seal holes left in the vertical mullions caused by temporary cleats.
 4. Insert and shape weatherseal joint backer rods, or gaskets, into vertical void between glass units and at a proper depth to receive silicone weatherseal sealant.
 5. Place silicone weatherseal sealant into void and tool flush with adjacent exterior glass light faces; remove excess sealant from glass and metal substrates.
- O. Glass Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in single sheet completely overlaying in pattern indicated on Drawings to the interior face of clean glass, according to manufacturer's written instructions, using the squeegee technique to remove moisture.
1. Cut film edges neatly and square at a uniform distance of 1/16 inch (1.5 mm) to 1/32 inch (0.75 mm) of the window sealing device. Avoid scoring glass when cutting film.
- P. Erection Tolerances:
1. Maximum Deviation from Vertical: 1/8 inch in any story and 1/4 inch in any 45 foot run.
 2. Maximum Deviation from Horizontal: 1/8 inch in any 30 foot run.
 3. Maximum Deviation from True Alignment: 1/32 inch for any two (2) abutting units. Allow no edge projections.
 4. Maximum Joint Gap: 1/32 inch.

3.4 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 1. If contaminating substances come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

PART 4 SCHEDULE

4.1 GLAZING SCHEDULE

- A. Film Overlay (F):
 1. F1: Privacy Film Overlay: Matte privacy film.
 - a. Basis of Design: "LLumar Decorative Frost Film – Acid Etch" manufactured by Eastman, a subsidiary of CPFilms, Inc.

2. F2: Decorative Film Overlay: film.
 - a. Basis of Design: "LLumar Decorative _____ Film - _____" manufactured by Eastman, a subsidiary of CPFilms, Inc.
- B. Acoustical Glazing (GA):
 1. GA1: Acoustical Glazing: Glass unit consisting of 1/4 inch (6 mm) clear, tempered glass laminated to 3/8 inch (9 mm) clear float glass comprised of two 3/16 inch (4.5 mm) clear float glass lites laminated to each other with clear 0.060 inch thick polyvinyl butyral (PVB) interlayer.
- C. Fire Resistant Glazing (GF):
 1. GF1: 5/16 inch, ceramic, premium, clear fire rated glass; 20 minute, listed and labeled for hose stream and positive pressure. Rated for impact safety in accordance with CPSC 16 CFR 1201 Cat. II (400 foot pounds).
- D. Float Glass (GG):
 1. GG1: Float Glass: 1/4 inch (6 mm) clear float glass.
- E. Insulating Glazing Units (GI):
 1. GI1: 1 inch thick insulating glazing unit comprised of a 1/4 inch thick glazing quality Low-e, tinted, tempered, float glass exterior lite with a 1/4 inch thick glazing quality clear tempered float glass interior lite, separated by a 1/2 inch argon-fill space and having the following properties:
 - a. Performance Requirements:
 - 1) U-Factor: 0.50 (maximum).
 - 2) Solar Heat Gain Coefficient: 0.25 (maximum).
 - b. Basis of Design: Product manufactured by Pilkington North America.
 - 1) Color:
 - (a) Exterior Lite: EverGreen.
 - (b) Interior Lite: Clear.
 - 2) Coatings:
 - (a) Eclipse Advantage on Surface #2.
 - (b) Energy Advantage on Surface #4.
 - 3) Visible Transmittance (%): 43.
 - 4) Winter Night-time U-value: 0.27.
 - 5) Solar Heat Gain Coefficient: 0.25.
- F. Laminated Safety Glazing (GL):
 1. GL1: 1/4 inch (6 mm) laminated safety glass comprised of two (2) 1/8" (3 mm) glazing quality clear float glass lites, laminated to each side of a clear 0.03 inch polyvinyl butyral (PVB) interlayer.
- G. Spandrel Glazing (GS):
 1. GS1: Spandrel Glass: As GI-1 with water-based silicone coating (Opaci-Coat-300) on surface #4.
 - a. Color: Warm Gray.
- H. Tempered Glazing (GT):
 1. Type GT1: 1/4 inch thick glazing quality, clear, tempered float glass.

END OF SECTION

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SECTION 08 83 00 - MIRRORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass Mirrors.
 - 1. Annealed Float Glass.
 - 2. Tempered Safety Glass.

1.2 RELATED REQUIREMENTS

- A. Section 06 20 00 - Finish Carpentry: Wood mirror frames.
- B. Section 10 28 00 - Toilet, Bath, and Laundry Accessories: Metal mirror frames.

1.3 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- D. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.
- H. GANA (GM) - GANA Glazing Manual; 2022.
- I. GANA (SM) - GANA Sealant Manual; 2008.

1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds: Submit chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit two samples, 6 x 6 inch (150 x 150 mm) in size, illustrating mirrors design, edging, coloration, and _____.
- E. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Mirror Glazing: One of each type and size.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.
 - 1. Maintain one copy on project site.
- B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with manufacturer's recommendations.

1.6 FIELD CONDITIONS

- A. Do not install mirrors when ambient temperature is less than 50 degrees F (10 degrees C).

- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Mirrors:
 - 1. Binswanger Mirror/ACI Distribution: www.binswangerglass.com/#sle.
 - 2. Lenoir Mirror Co: www.lenoirmirror.com/#sle.
 - 3. Trulite Glass and Aluminum Solutions: www.trulite.com/#sle.
 - 4. Walker Glass Company Ltd; Walker Glass Mirrors: www.walkerglass.com/#sle.
 - 5. Substitutions: Refer to Section 01 60 00 - Product Requirements.
- B. Decorative Mirrors:
 - 1. GGI - General Glass International; Antique Mirror: www.generalglass.com/#sle.
 - 2. Walker Glass Company Ltd; Walker Textures Acid-Etched Mirrors: www.walkerglass.com/#sle.
 - 3. Substitutions: Refer to Section 01 60 00 - Product Requirements.

2.2 MATERIALS

- A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
- B. Mirror Glass: Clear, annealed float glass; ASTM C1036, with copper and silver coatings, and protective overcoating.
 - 1. Thickness: 1/4 inch (6.4 mm).
 - 2. Edges: Arrised.
 - 3. Size: As indicated on drawings.
- C. Mirror Glass: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503.
 - 1. Thickness: 1/4 inch (6 mm).
 - 2. Size: As indicated on drawings.

2.3 GLAZING COMPOUNDS

- A. Acrylic Sealant: ASTM C920, Type S, Grade NS, Class 12-1/2, Uses M and A; single component, solvent curing, non-bleeding; cured Shore A hardness of 15 to 25; clear color.
- B. Polysulfide Sealant: ASTM C920, Type M, Grade NS, Class 25, Uses M and A ; two component; chemical curing, non-sagging type; cured Shore A hardness of 15 to 25; color as selected.
- C. Polyurethane Sealant: ASTM C920, Type S, Grade NS, Class 25, Uses M and A; single component, chemical curing, non-staining, non-bleeding, Shore A Hardness Range 20 to 35; color as selected.
- D. Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Uses M and A; single component; chemical or solvent curing; non-bleeding, non-staining, cured Shore A hardness of 15 to 25; _____ color.

2.4 ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness.

- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness.
- C. Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness; on release paper.
- D. Glazing Clips: Manufacturer's standard type.
- E. Mirror Attachment Accessories: Stainless steel clips.
- F. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.
 - 1. Application Temperature: Minus 35 to 140 degrees F (Minus 37 to 60 degrees C) at contact surfaces.
 - 2. Volatile Organic Content (VOC): Less than 7 percent by weight.
- G. Rolled Formed Frame: One piece, roll-formed angle frame, stainless steel, Type 430, satin finish, with welded frame corners, ground and polished smooth.
- H. J-Shape Frame: Aluminum extrusion, dimensions as detailed on drawings.
 - 1. Material: Comply with ASTM B221 (ASTM B221M), 6005-T6 alloy and temper.
 - 2. Finish: Anodized, clear.
 - 3. Four-Sided Frame: Mitered joints.
 - 4. Manufacturers:
 - a. Eagle Mouldings, Inc; Aluminum J Caps and Channels: www.eagle-aluminum.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- I. U-Shape Frame: Aluminum extrusion, dimensions as detailed on drawings.
 - 1. Material: Comply with ASTM B221 (ASTM B221M), 6005-T6 alloy and temper.
 - 2. Finish: Anodized, clear.
 - 3. Four-Sided Frame: Mitered joints.
 - 4. Manufacturers:
 - a. Eagle Mouldings, Inc; Aluminum Channel Extrusions: www.eagle-aluminum.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- J. Channel Frame: One piece, channel frame, stainless steel, Type 430, satin finish, 1/2 inch by 1/2 inch by 3/8 inch deep (12.7 mm by 12.7 mm by 9.5 mm deep) with 90 degree mitered corners.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that openings for mirrored glazing are correctly sized and within tolerance.
- B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous mirror frames or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.
- C. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.3 INSTALLATION

- A. Install mirrors in accordance with manufacturer's recommendations.
- B. Set mirrors plumb and level, and free of optical distortion.

- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
- D. Installation in Frames:
 - 1. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
 - 2. Place setting blocks at one-quarter points with edge block no more than 6 inches (152 mm) from corners.
 - 3. Rest mirrors on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
 - 4. Place glazing tape on free perimeter of mirrors in same manner described above.
 - 5. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
 - 6. Trim protruding tape edge.
- E. Installation in Frames:
 - 1. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
 - 2. Place setting blocks at one-quarter points with edge block no more than 6 inches (152 mm) from corners.
 - 3. Rest mirrors on setting blocks and push against tape to ensure full contact at perimeter of mirror.
 - 4. Install removable stops, insert spacer shims between mirrors, and apply stops at 24 inches (610 mm) on center and at 1/4 inch (6.4 mm) below sight line.
 - 5. Fill gaps between mirror and applied stop with sealant to depth equal to bite on glazing, to uniform and level line.
 - 6. Trim protruding tape edge.
- F. Installation in Frames:
 - 1. Install mirrors resting on setting blocks. Install applied stop and center mirror by use of spacer shims at 24 inches (610 mm) on center and at 1/4 inch (6 mm) below sight line.
 - 2. Locate and secure mirror using spring wire clips.
 - 3. Fill gaps between mirror and stops with glazing compound until flush with sight line, and tool surface to straight flush line.
- G. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.
- H. Frameless Mirrors: Set mirrors with clips, and anchor rigidly to wall construction.

3.4 CLEANING

- A. Remove wet glazing materials from finish surfaces.
- B. Remove labels after work is complete.
- C. Clean mirrors and adjacent surfaces.

END OF SECTION

SECTION 09 05 00 - COMMON WORK RESULTS FOR FINISHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Substrate testing.
 - 2. Waterproof membranes.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete: Concrete design, underslab vapor barrier and finished concrete surface required to accept flooring adhesive and finish flooring system.
 - 2. Section 03 54 00 - Cast Underlayment: Leveling of existing concrete slabs.
 - 3. Section 05 77 00 - Decorative Extruded Metal: Extruded metal transitions and trim.
 - 4. Section 06 10 00 - Rough Carpentry: Wood-based panel underlayment required to accept installation of finish flooring systems.
 - 5. Section 06 16 00 - Sheathing: For proper wood-based panel underlayment required to accept installation of finish flooring systems.
 - 6. Section 09 05 61 - Common Work Results for Flooring Preparation.
 - 7. Section 09 30 00 - Tiling.
 - 8. Section 09 65 00 - Resilient Flooring.
 - 9. Section 09 65 13 - Resilient Base and Accessories.
 - 10. Section 09 68 00 - Carpeting.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- C. ASTM C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method; 2007 - Not Active.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2021.
- F. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
- G. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- H. ASTM F1482 - Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring; 2021.
- I. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- J. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- K. ISO/IEC 17025 - General Requirements for the Competence of Testing and Calibration Laboratories; 2017.
- L. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.4 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
 - 1. Adhesives.
 - 2. Leadership in Energy and Environmental Design (LEED).
 - 3. Volatile Organic Compound (VOC)

1.5 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's printed descriptions of materials, components and systems; performance criteria; use limitations; preparation instructions and recommendations; storage and handling requirements and recommendations; and installation methods.
- B. Certificates:
 - 1. Submit with manufacturer's signature certifying that each product and/or system meets the requirements of the performance characteristics, physical criteria, and applicable standards specified.
 - a. Provide Master Grade Certificate as specified in ANSI A137.1.
- C. Test and Evaluation Reports:
 - 1. Submit certified test results by a recognized testing laboratory in accordance with specified test methods for each product and/or system indicating physical, chemical and performance characteristics.
- D. Samples:
 - 1. Submit samples showing full range of color and texture variations expected.
 - 2. Full size units of each type and composition of tile and for each color and finish required.
 - 3. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required; minimum 12 inches (300 mm) square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
 - 4. Waterproof membrane in 6 inch by 6 inch (150 mm by 150 mm) sample.
 - 5. Thresholds in 6 inch (150 mm) lengths.
- E. Closeout Submittals:
 - 1. Operation and Maintenance Data: Including, but not limited to, methods for maintaining installed products and precautions against cleaning materials with methods detrimental to finishes and performance.
 - 2. Executed Warranty Documentation: Manufacturers' material warranties and installers workmanship warranty.
 - 3. Record Documents: Drawings, Specifications, Product Data.

1.6 PERFORMANCE REQUIREMENTS

- A. Refer to the following for specific sub-flooring and finish flooring requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 03 54 00 - Cast Underlayment.
 - 3. Section 06 10 00 - Rough Carpentry: Sub-flooring.
 - 4. Section 09 30 00 - Tiling.
 - 5. Section 09 65 00 - Resilient Flooring.
 - 6. Section 09 68 00 - Carpeting.
- B. Static Coefficient of Friction (SCOF): For tile installed on walkway surfaces which are not anticipated to be wet, provide products with values determined by testing identical products per ASTM C1028:
 - 1. Level Surfaces: Minimum 0.6.
 - 2. Ramp Surfaces: Minimum 0.8.
- C. Dynamic Coefficient of Friction (DCOF): Per ANSI A137.1 Section 9.6 DCOF AcuTest:

1. Wet Level Surfaces: Minimum 0.42 unless noted otherwise.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Surface Burning Characteristics: ASTM E84; identify products with appropriate markings of applicable testing agency.
 - a. Flame Spread Index: 25 or less.
 - b. Smoke Developed Index: 450 or less.
 2. Accessibility Requirements: Comply with applicable requirements.
 - a. ADA Standards.
 - b. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
- B. Qualifications:
1. Installer / Applicator: Perform installation with skilled, experienced and trained workmen supervised by trained personnel who shall have a minimum three (3) years successful experience in installations of similar size and scope.
 2. Testing Agency: An independent testing agency with the experience and capability to conduct the testing indicated, meeting requirements of ISO/IEC 17025 or ASTM E329 and ASTM E699.
- C. Source Limitations:
1. Obtain spray-applied adhesive through one source from a single manufacturer.
 2. Obtain tile of same type and color or finish from one source or producer. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.
 3. Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.
 - a. Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
 - 1) Waterproofing.
 - 2) Joint sealants.
 - 3) Cementitious backer units.
 - 4) Metal edge strips.
- D. Sustainability Standards and Certifications:
1. Adhesive and Sealant VOC Limits: According to South Coast Air Quality Management District Rule 1168 and GS-36 for aerosols.
 2. VOC Limits: As tested using U.S. EPA Reference Test Method 24 and as defined by
 - a. South Coast Air Quality Management District Rules: In areas where exposure to freeze/thaw conditions and direct exposure to moisture will not occur.
 - 1) SCAQMD Rule 1168, Adhesive and Sealant Applications
 - b. California Air Resources Board: For areas where freeze/thaw conditions do exist or direct exposure to moisture can occur.
 - 1) CARB for containers 16 oz. or less.
- E. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup of each type of floor tile installation.
 2. Build mockup of each type of wall tile installation.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, Storage and Handling per manufacturer's recommendations, Section 01 60 00 - Product Requirements, and as follows:
1. Delivery and Acceptance Requirements

- a. Deliver materials to Project site in an undamaged condition, in original, unopened and undamaged packages or containers bearing manufacturer's intact label, names, brand names, types and thicknesses of contents, and proper handling, storing, unpacking, protecting, and installation instructions, as warranted.
 - 1) Comply with requirements in ANSI A137.1 for labeling tile packages.
 - b. Inspect shipped materials on delivery to ensure compliance with requirements of Contract Documents and to ensure that products are undamaged and properly protected. Reject damaged goods and accept properly ordered, protected and undamaged goods.
2. Storage and Handling Requirements
 - a. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided. Store liquid materials in unopened containers and protected from freezing.
 - b. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.
 - c. Store adhesive materials in a dry, temperature-controlled interior area at 65-80 deg F (18-27 deg C). Protect materials from damage from improper handling, exposure to temperature extremes, and the action of other trades.
 3. Packaging Waste Management
 - a. Request in writing that manufacturers, fabricators, suppliers and shippers provide least amount of packaging that adequately and properly protects, supports and contains the items shipped, and is reusable, returnable or recyclable.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.
- B. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.
- C. Maintain temperatures at 50 degrees F or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.10 EXTRA STOCK

- A. Refer to related sections for extra stock requirements.

1.11 PRE-INSTALLATION CONFERENCE

- A. Refer to Section 01 31 00 - Project Management and Coordination.

1.12 WARRANTY

- A. Refer to related sections for specific product warranty requirements.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 FIELD CONDITIONS

- A. Conditions and Measurements: Visit jobsite to verify installation conditions and floor measurements.
- B. Ambient Conditions per manufacturer's written recommendations, and as follows:

1. New concrete slabs shall be flat, clean and dry meeting all moisture tests passing manufacturer's written requirements.
2. Environmental Limitations: Maintain temperature and relative humidity per manufacturer's recommendations.
 - a. Maintain space, substrate temperatures, and RH for time prior to, during and after installation as recommended.
3. Acclimate floor finish materials into spaces they will be installed a minimum 48 hours in advance of installation.
 - a. Do not install until all floor finish materials are same temperature as space where they are to be installed.

3.2 EXAMINATION - GENERAL

- A. Contractor shall examine preparatory work by others, with Installer/Applicator present, for compliance with requirements affecting Work performance.
 1. Contractor shall notify Architect of any issues which would affect installation of finish. Absence of such notification shall constitute acceptance of responsibility by Contractor.
- B. Verify that field measurements, surfaces, substrates, structural support, tolerances, levelness, plumbness, temperature, humidity, moisture content level, cleanliness, and other conditions are as required by the manufacturer, and ready to receive Work.

3.3 EXAMINATION - FLOORING

- A. Verify that concrete floors to receive resilient flooring meet ASTM F710 requirements and are flat as recommended by floor finish manufacturer.
- B. Verify that wood and panel type underlayment substrates to receive resilient flooring meet ASTM F1482 requirements and are flat as recommended by floor finish manufacturer.
- C. Test substrates as required by manufacturer to verify proper conditions.
 1. Portland-Cement Concrete:
 - a. Perform moisture testing to verify that concrete substrate is sound and dry. Both of the following tests are required:
 - 1) Perform relative humidity (RH) test using in situ probes per ASTM F2170 . Proceed with installation only after each substrate measures a maximum 75 percent RH.
 - 2) Perform anhydrous calcium chloride testing per ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 7 lbs of water/1000 sf (3.18 kg of water/92.9m²) in 24 hours.
 - b. Perform alkalinity testing to verify pH level is 11 or below per ASTM F710.
 - c. Perform bond testing per ASTM F710 to determine compatibility of adhesive to concrete substrate.
 2. Wood Underlayment: Shall be dry, clean, structurally sound, well nailed and/or glued, free of voids and with joints that do not exceed 1/16 inch (1.6mm) per floor finish manufacturer's installation instructions.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.
 - a. Commencement of work related to this Section will constitute acceptance of conditions.

3.4 INSTALLATION - GENERAL

- A. Lay out tiling so that no tile is cut to less than 1/2 of its full size in either direction.
- B. Slope tile within 3 foot diameter of a floor drain, unless otherwise noted.
- C. Form internal angles square.

3.5 INSTALLATION - STONE SHRESHOLDS

- A. Set marble thresholds in accordance with TCA TR611 and manufacturer's instructions.

3.6 FIELD QUALITY CONTROL

A. Site Tests and Inspections:

1. Inspect floor finish system installation for non-conforming Work including, but not limited to, the following:
 - a. Lack of adequate adhesion.
 - b. Adhesive overspray.
 - 1) Clean off water-based adhesive overspray with a damp cloth.
 - c. Improper substrate preparation as indicated by:
 - 1) Air blisters.
 - 2) Buckling.
 - 3) Cracks.

3.7 CLEANING

- #### **A. Clean finishes as required and in accordance with manufacturer's recommendations.**

3.8 CLOSEOUT ACTIVITIES

- #### **A. Refer to Section 01 77 00 - Closeout Procedures.**

END OF SECTION

SECTION 09 05 61 - COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
1. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - a. Resilient tile and sheet.
 - b. Carpet tile.
 - c. Thin-set tile.
 2. Preparation of new and existing concrete floor slabs for installation of floor coverings.
 3. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - a. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
 4. Remedial floor coatings.
 5. Remedial floor sheet membrane.
 6. Crack isolation membrane.
- B. Related Sections:
1. Section 01 22 00 - Unit Prices: Bid pricing for remediation treatments if required.
 2. Section 01 23 00 - Alternates: Bid pricing for remediation treatments if required.
 3. Section 01 40 00 - Quality Requirements: Additional requirements relating to testing agencies and testing.
 4. Section 01 74 19 - Construction Waste Management and Disposal: Handling of existing floor coverings removed.
 5. Section 02 41 00 - Demolition: Removal of existing flooring.
 6. Section 03 30 00 - Cast-in-Place Concrete: Moisture emission reducing curing and sealing compound for slabs to receive adhered flooring, to prevent moisture content-related flooring failures; to remain in place, not to be removed.
 7. Section 03 30 00 - Cast-in-Place Concrete: Concrete admixture for slabs to receive adhered flooring, to prevent moisture content-related flooring failures.
 8. Section 03 30 00 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.
 9. Section 07 95 13 - Expansion Joint Cover Assemblies.
 10. Section 09 65 00 - Resilient Flooring.
 11. Section 09 68 00 - Carpeting.

1.3 REFERENCE STANDARDS

- A. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).

1.4 DEFINITIONS

- A. Refer to Section 01 42 16 - Definitions for the following terms:
1. Adhesives.
 2. Leadership in Energy and Environmental Design (LEED).
 3. Volatile Organic Compound (VOC).

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.6 SUBMITTALS

- A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- B. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
 - 1. Manufacturer's qualification statement.
 - 2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
 - 3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
 - 4. Manufacturer's installation instructions.
 - 5. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.
- C. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and alkalinity (pH) test reports.
 - 4. Copies of specified test methods.
 - 5. Recommendations for remediation of unsatisfactory surfaces.
 - 6. Product data for recommended remedial coating.
 - 7. Include certification of accuracy by authorized official of testing agency.
 - 8. Submit report directly to Owner.
 - 9. Submit report to Architect.
 - 10. Submit report not more than two business days after conclusion of testing.
- D. Adhesive Bond and Compatibility Test Report.
- E. Floor Moisture Testing Technician Certificate: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician- Grade I certificate.

1.7 PERFORMANCE REQUIREMENTS

- A. Refer to the following for specific sub-flooring and finish flooring requirements:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 03 54 00 - Cast Underlayment.
 - 3. Section 06 10 00 - Rough Carpentry: Sub-flooring.

1.8 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Contractor may perform adhesive and bond test with Contractor's own personnel or hire a testing agency.
- C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- D. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.

2. Confirm date of start of testing at least 10 days prior to actual start.
 3. Allow at least 4 business days on site for testing agency activities.
 4. Achieve and maintain specified ambient conditions.
 5. Notify Owner when specified ambient conditions have been achieved and when testing will start.
 6. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- E. Floor Moisture Testing Technician Qualifications: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician Certification- Grade I.
- F. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.10 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 MATERIALS

- A. Patching Compund: Refer to Section 03 54 00 - Cast Underlayment
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Spray-Applied Adhesive:
 1. Water-based pressure-sensitive aerosol adhesive, VOC- Free, non-flammable, and non-HAP, emitting no dangerous fumes or odors.
 2. Manufacturers:
 - a. Spray-Lock by Interlock Industries, Inc., (706) 517-8989.
 3. Basis of Design Product(s):
 - a. Spray-Lock™ 6500 for adhering vinyl backed carpet tile, and luxury vinyl tiles (LVT) or planks.
 - b. Spray-Lock™ 9500 for adhering vinyl composition tile (VCT).

- c. Spray-Lock™ 3500 for adhering resilient sheet vinyl flooring; and formulated for use in Medical / Health Care applications.
- D. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 2. Use product recommended by testing agency.
 3. Basis of Design:
 - a. Allied Construction Technologies, Inc; AC Tech 2170: www.actechperforms.com/#sle.
 - b. ARDEX Engineered Cements; ARDEX MC RAPID: www.ardexamericas.com/#sle.
 - c. AVECS, LLC; RE-ACT: www.avecs.build/#sle.
 - d. Crown Polymers, a division of American Polymers Corporation; CrownShield 8303 MVB: www.crownpolymers.com/#sle.
 - e. Custom Building Products; TechMVC Moisture Vapor and Alkalinity Barrier: www.custombuildingproducts.com/#sle.
 - f. Floor Seal Technology, Inc; MES 100 with Floor Seal FloorCem SLU: www.floorseal.com/#sle.
 - g. GCP Applied Technologies; Kovara AB 300: www.gcpat.com/#sle.
 - h. H.B. Fuller Construction Products, Inc; TEC LiquiDam with TEC Level Set 200 SLU: www.tecspecialty.com/#sle.
 - i. Koster American Corporation; _____: www.kosterusa.com/#sle.
 - j. LATICRETE International, Inc; LATICRETE NXT Vapor Reduction Coating with LATICRETE NXT Level Plus: www.laticrete.com/#sle.
 - k. LATICRETE International, Inc; LATICRETE SUPERCAP Moisture Vapor Control with LATICRETE SUPERCAP Underlayment: www.laticrete.com/#sle.
 - l. Loba-Wakol, LLC; WAKOL PU 280 Moisture Barrier: www.loba-wakol.com/#sle.
 - m. Maxxon Corporation; Aquafin SG2: www.maxxon.com/#sle.
 - n. Polycoat Products; Polycoat PC FMB; www.polycoatusa.com/#sle.
 - o. Proflex Products, Inc; Moisture Barrier 25 with DPU - Deep Pour Underlayment: www.proflex.us/#sle.
 - p. Rust-Oleum Corporation; TVB - Topside Vapor Barrier 100% Solids: www.rustoleum.com/#sle.
 - q. Sika Corporation; Sikafloor Moisture Tolerance Epoxy Primer and Sikafloor Self-Leveling Moisture Tolerant Resurfacer: www.sikafloorusa.com/#sle.
 - r. Stauf USA, LLC; ERP-270 Perma-Seal: www.staufusa.com/#sle.
 - s. Tnemec Company, Inc; Series 208 Epoxoprime MVT: www.tnemec.com/#sle.
 - t. USG Corporation; Durock Brand CST Moisture Vapor Reducer: www.usg.com/#sle.
 - u. UZIN UTZ NORTH AMERICA, INC; UZIN PE 460 with UZIN PE 280 and UZIN NC 170 LevelStar: us.uzin.com/#sle.
- E. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
1. Thickness: 28 mil (0.028 inch) (0.711 mm).
 2. Tape: Types recommended by underlayment manufacturer to install membrane and cover seams.
 3. Basis of Design:
 - a. GCP Applied Technologies; Kovara MBX: www.gcpat.com/#sle.
- F. Crack Isolation Membrane:

1. Description:
 - a. Sheet membrane used to eliminate transmission of substrate cracks
2. Products and Manufacturers:
 - a. Sheet Membranes:
 - 1) Crack Buster Pro manufactured by Custom Building Products, a Quikrete Company.
 - 2) Dalseal CIS manufactured by Dal-Tile.
 - 3) Fracture Ban manufactured by Laticrete.
 - 4) Mapeguard 2 manufactured by Mapei.
 - 5) Nobleseal CIS manufactured by The Noble Company.
 - 6) Tileguard manufactured by Polyguard Products, Inc.
 - b. Liquid membrane with fiberglass mesh from one (1) of the following approved Products/Manufacturers in accordance with ANSI A118.12:
 - 1) Blue 92 manufactured by Laticrete International, Inc.
 - 2) Fracturefree manufactured by Custom Building Products.
 - 3) Mapelastc CI manufactured by Mapei.
 - 4) Hydro-rite FS manufactured by Texrite.

PART 3 EXECUTION

3.1 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Refer to Section 02 41 00 - Demolition.

3.2 CONCRETE SLAB PREPARATION

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:
 1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
 - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
 - b. Removal of existing floor covering in accordance with Section 02 41 00 - Demolition.
 2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
 - a. Do not attempt to remove coating or penetrating material.
 - b. Do not abrade surface.
 3. Preliminary cleaning.
 4. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
 5. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 6. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 7. Specified remediation, if required.
 8. Patching, smoothing, and leveling, as required.
 9. Other preparation specified.
 10. Adhesive bond and compatibility test.
 11. Protection.
- C. Remediations:
 1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.

3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.3 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.4 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.
- F. Report: Report the information required by the test method.

3.5 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

3.6 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
 1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
 2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.

3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
- C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.7 PREPARATION

- A. Refer to individual floor covering section(s) for additional requirements.
- B. Comply with recommendations of testing agency.
- C. Comply with requirements and recommendations of floor covering manufacturer.
- D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- E. Do not fill expansion joints, isolation joints, or other moving joints.

3.8 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.9 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.10 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

- A. Install in accordance with sheet membrane manufacturer's instructions.

3.11 APPLICATION OF SPRAY-APPLIED ADHESIVE

- A. Installation per each floor finish assembly product manufacturer's written instructions, and as follows:
 1. Spray-Applied Adhesive Method:
 - a. Do not place finish-flooring product until adhesive applied to substrate is ready to receive it per adhesive manufacturer's instructions.
 - b. Mark floor equivalent to manufacturer's recommended area for size of container used. Apply no more or less adhesive than what manufacturer recommends.
 - c. Outline perimeter of the room with a 4-5 inch (100-125 mm) wide band of adhesive. Apply the adhesive from 8-12 inches (200-300 mm) above the substrate.
 - d. Lay flooring finish material, adjust and reset until layout placement is certain.
 - e. Following installation of finish flooring (typically within an hour after installing) roll entire floor area with a 75 to 100 lb (34 to 45 kg) roller to ensure proper bonding with instant shear strength.
 2. Close space to traffic for 2 hours before beginning installation, however, flooring is immediately available after rolling for all range of use.

3.12 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

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SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Gypsum board.
 - 2. Partition framing systems.
 - 3. Exterior gypsum board for ceilings and soffits.
 - 4. Tile backing panels.
 - 5. Ceiling suspension systems.
 - 6. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Section 06 10 00 - Rough Carpentry: Building blocking.
 - 3. Section 07 21 00 - Thermal Insulation: Thermal insulation.
 - 4. Section 07 27 26 - Fluid-Applied Air Barrier System: Vapor barriers.
 - 5. Section 07 84 13 - Penetration Firestopping.
 - 6. Section 07 92 00 - Joint Sealants: Acoustical joint sealant.
 - 7. Section 08 44 13 - Glazed Aluminum Curtain Walls.
 - 8. Section 09 81 00 - Acoustic Insulation.

1.3 REFERENCE STANDARDS

- A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
- B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.
- C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017.
- H. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
- I. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- J. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
- K. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2018.
- L. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2020.

- M. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2019.
- N. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- O. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- P. ASTM C1288 - Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets; 2017.
- Q. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2021.
- R. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- S. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2019.
- T. ASTM C1766 - Standard Specification for Factory-Laminated Gypsum Panel Products; 2015 Edition, February 1, 2015.
- U. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- V. ASTM D3274 - Standard Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation; 2009 Edition, March 1, 2009
- W. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- X. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- Y. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- Z. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- AA. ASTM E1190 - 2021 Edition, November 15, 2021 Standard Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members; 2021 Edition, November 15, 2021.

1.4 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Comply with manufacturer's load tables and the following design pressures and deflections:
 - 1. Stairs, Elevator Hoistways, and Vertical Shafts: 1/120 at 10 psf.
 - 2. Ground Floor Lobbies: 1/120 at 15 psf.
 - 3. Partitions Receiving Stone Cladding, Lath and Plaster, or Plaster Veneer: 1/360 at 15 psf.
 - 4. Partitions Receiving Monitors, Televisions, Heavy Audio/Visual Equipment: 1/360 at 15 psf.
 - 5. Typical Partitions: 1/240 at 5 psf.
 - 6. Other Partitions: 1/240 at 5 psf.
 - a. Maximum Deflection:
 - 1) L/240 at 5 lbf per sq. ft.
 - 2) L/120 at 5 lbf per sq. ft.
 - 3) L/120 at 7.5 lbf per sq. ft.
 - 4) L/120 at 10 lbf per sq. ft.
- B. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

- C. STC Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

1.5 SUBMITTALS

- A. Product Data: Submit For each type of drywall including calculations for loadings and stresses of exterior walls and specially fabricated framing based on manufacturer's load tables.
- B. Shop Drawings: Indicate locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of work.
- C. Samples:
 - 1. Trim Accessories: Full size Sample in 12 inch (300 mm) long length for each trim accessory indicated.
 - 2. Textured Finishes: 12 inch by 12 inch (300 mm by 300 mm) for each textured finish indicated and on same backing indicated for work.
- D. Calculations: Submit calculations verifying steel partition stud minimum base metal thickness and depth compliance with Code and ASTM C645 for height, load, and deflection.
- E. Evaluation Reports: ICC-ES reports for dimpled steel studs and runners and firestop tracks.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with applicable requirements of building code for interior finishes.
 - 2. Fire Resistance Rated Assemblies: For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. Single Source Responsibility:
 - 1. Framing Members: Obtain steel framing members from single manufacturer.
 - 2. Panel Products: Obtain each type of gypsum board and other panel products from single manufacturer.
 - 3. Finishing Materials: To the extent possible, obtain finishing materials from same manufacturer supplying gypsum board products. When not possible, obtain materials from manufacturer acceptable to gypsum board manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 for gypsum board manufacturer's written instructions, whichever are more stringent.
 - 1. Do not install paper faced gypsum panels until installation areas are enclosed and conditioned.
- B. Room Temperatures: Maintain minimum 40 degrees F (4 degrees C). For adhesive attachment and finishing of gypsum board, maintain minimum 50 degrees F (10 degrees C) for 48 hours before application and continuously after until dry. Do not exceed 95 degrees F (35 degrees C) when using temporary heat sources.
- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

- D. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Steel Studs and Tracks:
 - a. CEMCO: www.cemcosteel.com.
 - b. ClarkDietrich: www.clarkdietrich.com.
 - c. Custom Stud, Inc.: www.customsteelcraft.com.
 - d. MBA Building Supplies: www.mbastuds.com.
 - e. MRI Steel Framing, LLC: www.mristeel framing.com.
 - f. Phillips Manufacturing Co.: www.phillipsmfg.com.
 - g. Steel Network, Inc. (The): www.steelnetwork.com.
 - h. Telling Industries: www.tellingindustries.com.
 - 2. Ceiling Suspension System:
 - a. Armstrong World Industries, Inc.: www.armstrongceilings.com.
 - b. Rockfon: www.rockfon.com.
 - c. USG Corporation: www.usg.com.
 - 3. Gypsum Board:
 - a. Certainteed Corporation: www.certainteed.com.
 - b. Georgia Pacific: www.gp.com.
 - c. National Gypsum Company: www.nationalgypsum.com.
 - d. USG Corporation: www.usg.com.
 - 4. Tile Backer Board:
 - 5. Glass Mat Gypsum Sheathing Board:
 - a. USG Corporation: www.usg.com.
 - 6. Cementitious Board:
 - a. Custom Building Products: www.custombuildingproducts.com.
 - b. National Gypsum Company: www.nationalgypsum.com.
 - c. USG Corporation: www.usg.com.
 - 7. Trim:
 - a. Fry Reglet Corporation: www.fryreglet.com.
 - b. Gordon, Inc.: www.gordon-inc.com.
 - c. Pittcon Industries: www.pittconindustries.com.
 - d. Schluter Systems: www.schluter.com.
 - 8. Extruded Partition Closure:
 - a. Gordon, Inc.: www.gordon-inc.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 MATERIALS

- A. Framing Members: ASTM C754 for component sizes and conditions under specified maximum deflection and lateral loading conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C645 requirements for metal.
 - 2. Protective Coating:

- a. Standard: ASTM A653/A653M, G40, hot dip galvanized.
 - b. Enhanced: ASTM A653/A653M, G60, hot dip galvanized.
- B. Steel Framing Components: ASTM C754 for conditions indicated; hot dip galvanize complying with ASTM A653/A653M Z180.
1. Steel Studs and Runners: ASTM C645, 0.0179 inch (0.45 mm) minimum base metal thickness; depth indicated on Drawings.
 2. Dimpled Steel Studs and Runners: ASTM C645, equivalent to minimum base metal thickness indicated on Drawings for depth indicated on Drawings.
 3. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
 4. Cold-Rolled Channel Bridging: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges; depth indicated on Drawings.
 5. Clip Angle: Not less than 1-1/2 inches by 1-1/2 inches (38.1 mm by 38.1 mm), 0.068 inch (1.73 mm) thick, galvanized steel.
 6. Hat Shaped, Rigid Furring Channels: ASTM C645; 0.0179 inch (0.45 mm) minimum base metal thickness; depth indicated on Drawings.
 7. Resilient Furring Channels: 1/2 inch (12.7 mm) deep, steel sheet members designed to reduce sound transmission. Configuration: Asymmetrical or hat shaped.
 8. Cold Rolled Furring Channels 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges.
 - a. Depth: As indicated on Drawings.
 - b. Furring Brackets: Adjustable, corrugated edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
 - c. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.
 9. Z-Shaped Furring Channels: With slotted or non-slotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.
 10. Auxiliary Framing Materials: Fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
 11. Slip Type Head Joints: Where indicated, provide one of the following:
 - a. Single Long Leg Runner System: ASTM C645 top runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging, located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
 - b. Double Runner System: ASTM C645 top runners, inside runner with 2 inch (50.8 mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 - c. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide one of the following:
 - 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
 - 2) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
 - 3) Superior Metal Trim; Superior Flex Track System (SFT).
 12. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire resistance rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs. Provide one of the following:
 - a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
 - b. Grace Construction Products; FlameSafe FlowTrak System.
 - c. Metal-Lite, Inc.; The System.
 - d. Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series as applicable.

- C. Ceiling Suspension System:
1. Basis of Design:
 - a. Drywall Grid Systems manufactured by Armstrong World Industries, Inc.
 2. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.0625 inch (1.59 mm) diameter wire, or double strand of 0.0475 inch (1.21 mm) diameter wire.
 3. Hanger Attachments to Concrete:
 - a. Anchors: Post-installed, chemical anchor or post-installed, expansion anchor fabricated from corrosion resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E488/E488M by an independent testing agency.
 - b. Powder Actuated Fasteners: Suitable for application indicated, fabricated from corrosion resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E1190 by an independent testing agency.
 4. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.162 inch (4.12 mm) diameter.
 5. Carrying Channels: Cold rolled, commercial steel sheet with base metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2 inch (12.7 mm) wide flanges. Depth indicated on Drawings.
 6. Furring Channels (Furring Members):
 - a. Cold Rolled Channels: 0.0538 inch (1.37 mm) bare steel thickness, with minimum 1/2 inch (12.7 mm) wide flanges, 3/4 inch (19.1 mm) deep.
 - b. Steel Studs: ASTM C645; minimum base metal thickness of 0.0312 inch (0.79 mm); Depth as indicated on Drawings.
 - c. Hat Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch (22.2 mm) deep; Minimum base metal thickness of 0.0312 inch (0.79 mm).
 7. Resilient Furring Channels: 1/2 inch (12.7 mm) deep members designed to reduce sound transmission.
 8. Grid Suspension System for Ceilings: ASTM C645, direct hung system composed of main beams and cross furring members that interlock.
- D. Gypsum Board: ASTM C1396/C1396M, applicable to type of gypsum board indicated and whichever is more stringent.
1. Wall Board:
 - a. Type: X.
 - b. Thickness: 5/8 inch (15.9 mm).
 - c. Long Edges: Tapered and featured (rounded or beveled) for pre-filling.
 2. Ceiling Board: Manufactured for sag resistance
 - a. Type: X typical, C at fire-resistance-rated ceiling assemblies.
 - b. Thickness: 1/2 inch (13 mm).
 - c. Long Edges: Tapered.
 3. Moisture and Mold Resistant Type: Type X with moisture and mold resistant core and surfaces.
 - a. Type: X.
 - b. Thickness: 5/8 inch (15.9 mm).
 - c. Long Edges: Tapered.
 4. Shaft Liner Type:
 - a. Type: X.
 - b. Thickness: 1 inch (25.4 mm).
 5. Fire-Resistant Core, Foil-Backed: ASTM C1396/C1396M

- a. Basis of Design: Gold Bond® Foil Back Gypsum Board manufactured by National Gypsum Company.
 - b. Thickness: 5/8 inch (15.9 mm).
 - c. Core: Type X.
 - d. Edges: Tapered.
- E. Impact Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
1. Core and Thickness: 5/8 inch (15.9 mm), Type X.
 2. Surface Abrasion: ASTM C1629/C1629M, meet or exceed Level 1 requirements.
 3. Indentation: ASTM C1629/C1629M, meet or exceed Level 1 requirements.
 4. Soft Body Impact: ASTM C1629/C1629M, meet or exceed Level 1 requirements.
 5. Hard Body Impact: ASTM C1629/C1629M, meet or exceed Level 1 requirements according to test in Annex A1.
 6. Long Edges: Tapered.
 7. Mold Resistance: ASTM D3273, score of 10 as rated according to STM D3274.
- F. Acoustically Enhanced Gypsum Board: ASTM C1766. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.
1. Manufacturers: Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of ten (10) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - a. CertainTeed Corp.; Silent FX QC.
 - b. National Gypsum Company; Sound Break.
 - c. PABCO; QuietRock.
 - d. G-P/Temple Inland; Comfort Guard Sound.
 2. Core: Regular Type.
 3. Long Edges: Tapered.
- G. Reinforced Gypsum Sheathing (Tile Backer Board): ASTM C1178/C1178M, standard edges. Cellulose fiber reinforced panels may be used in lieu of cementitious board.
1. Core and Thickness: 5/8 inch (15.9 mm) to match conditions, Type X.
 2. Long Edge: Tapered.
 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- H. Glass Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with standard edges.
1. Core: Type X.
 2. Thickness: 5/8 inch (15.9 mm).
 3. Size: 48 inches by 96 inches (1219 mm by 2438 mm).
 4. Long Edges: Tapered
- I. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325.
1. Thickness: 1/2 inch (12.7 mm) and 5/8 inch (15.9 mm) to match conditions.
 2. Long Edges: Standard.
 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- J. Exterior Trim: ASTM C1047, hot dip galvanized steel sheet, plastic, or rolled zinc.
1. Shapes:
 - a. Cornerbead.
 - b. LC Bead: J shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One piece, rolled zinc with V shaped slot and removable strip covering slot opening.
- K. Interior Trim: ASTM C1047; galvanized or aluminum coated steel sheet, rolled zinc, plastic, or paper faced galvanized steel sheet.

1. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC Bead: J shaped; exposed long flange receives joint compound.
 - d. L Bead: L shaped; exposed long flange receives joint compound.
 - e. U Bead: J shaped; exposed short flange does not receive joint compound.
- L. Expansion (Control) Joint.
 1. Manufacturers: Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
- M. Decorative Trim and Reveals: Refer to Section 05 77 00 - Decorative Extruded Metal.
- N. Continuous Corner Bead: Extruded Aluminum; continuous integral fin for surface contact with gypsum board; 7/8 inch (22 mm) wide, tapered to edge; punched with holes staggered to accept screw fastening. Prime with corrosion resistant primer.
 1. Manufacturer: Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - a. Fry Reglet Corporation.
 - b. Pittcon Industries.
 - c. Schluter Systems.
 2. Basis of Design Product: Pittcon Softforms SO-HSE-90
- O. Joint Treatment: ASTM C475/C475M.
 1. Joint Tape:
 - a. Exterior Gypsum Soffit Board: Paper.
 - b. Joint Compound for Exterior Applications, Glass Mat Gypsum Sheathing Board: Recommended by sheathing board manufacturer.
 - c. Joint Tape, Interior Gypsum Board: Paper.
 2. Joint Compound:
 - a. Gypsum Board: Pre-Filling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting type taping compound.
 - 1) Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting type taping compound.
 - (a) Use setting type compound for installing paper faced metal trim accessories.
 - 2) Fill Coat: For second coat, use setting type, sandable topping compound.
 - 3) Finish Coat: For third coat, use setting type, sandable topping compound.
 - 4) Skim Coat: For final coat of Level 5 finish, use setting type, sandable topping compound.
 - b. Cementitious Units: Recommended by backer unit manufacturer.
 - c. Tile Backing Panels: Recommended by backer unit manufacturer.
 - d. Water Resistant Gypsum Backing Board: Use setting type taping compound and setting-type, sandable topping compound.
 - e. Joint Compound, Glass Mat Sheathing Board: Recommended by sheathing board manufacturer.
- P. Partition Closure:

1. Description: Extruded aluminum partition closures are pre-assembled and spring-loaded to provide a tight fit for vertical junctures of partitions and window assemblies.
 2. Basis of Design: "Mullion Mate High STC" as manufactured by Gordon, Inc.
 3. Material: 6063-T5 temper, tensile strength 31 KSI (ASTM B221/ASTM B221M).
 4. Sound Transmission: STC 50 minimum.
 5. Width: As required.
 6. Accessories:
 - a. Partition End Caps.
 7. Finish: Match adjacent storefront, window wall, or curtain wall system.
- Q. Auxiliary Materials: Comply with referenced installation standards and manufacturer's written recommendations.
1. Steel Drill Screws: ASTM C1002, use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 2. Sound Attenuation Blankets: Refer to Section 09 81 00 - Acoustic Insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow metal frames, cast in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION

- A. Installation Standard: ASTM C754, except comply with framing sizes and spacing indicated.
- B. Gypsum Board Assemblies: Comply with requirements in ASTM C840 applicable to framing installation.
- C. Suspension System: Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
1. Suspend hangers from building structure:
 - a. Install hangers plumb and free from contact with insulation or objects within ceiling plenum that are not part of supporting structural or suspension system. Splay hangers where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - b. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - 1) Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - c. Do not attach hangers to steel roof deck.
 - d. Do not attach hangers to permanent metal forms. Furnish cast in place hanger inserts that extend through forms.
 - e. Do not attach hangers to rolled in hanger tabs of composite steel floor deck.
 - f. Do not connect or suspend steel framing from ducts, pipes, or conduit.
 2. Fire Resistance Rated Assemblies: Wire tie furring channels to supports.

3. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
 4. Ceiling Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross furring members to each other and butt cut to fit into wall track.
- D. Framing Assembly: Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
1. Install studs so flanges within framing system point in same direction. Space studs in single layer application as indicated on drawings.
 2. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - a. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1) Install two studs at each jamb, unless otherwise indicated.
 - 2) Install cripple studs at head adjacent to each jamb stud, with minimum 1/2 inch (12.7 mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - 3) Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - b. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 3. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.
- E. Sound Insulation: Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- F. Gypsum Panels: Comply with ASTM C840. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
1. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
 2. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
 3. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
 4. Form control and expansion joints with space between edges of adjoining gypsum panels.
 5. Cover both faces of support framing with gypsum panels in concealed spaces, except in chases braced internally.
 - a. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - b. Fit gypsum panels around ducts, pipes, and conduits.
 - c. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 inch to 3/8 inch (6.4 mm to 9.5 mm) wide joints to install sealant.

6. Isolate perimeter of gypsum board applied to non-load bearing partitions at structural abutments, except floors. Provide 1/4 inch to 1/2 inch (6.4 mm to 12.7 mm) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
 7. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Gypsum Board: Install interior gypsum board where indicated on drawings.
1. Single Layer Application:
 - a. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
 - b. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire resistance rated assembly, and minimize end joints. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - c. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
 2. Multilayer Application:
 - a. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - b. On Z shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 - c. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- H. Backing Panels:
1. Cementitious Backer Units: ANSI A108.11; install where indicated with 1/4 inch (6.4 mm) gap where panels abut other construction or penetrations. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
- I. Exterior Gypsum Board Soffits: Apply panels perpendicular to supports, with end joints staggered and located over supports.
1. Install with 1/4 inch (6.4 mm) open space where panels abut other construction or structural penetrations.
 2. Fasten with corrosion-resistant screws.
- J. Trim Accessories: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Attach trim according to manufacturer's written instructions.
1. Control Joints: Install control joints according to ASTM C840 (30 feet maximum), at each door and window jamb (unless noted otherwise), and in specific locations indicated on Drawings.
 2. Exterior Trim: Install in the following locations:
 - a. Cornerbead: Use at outside corners.
 - b. LC Bead: Use at exposed panel edges.
 3. Interior Trim: Install in the following locations:
 - a. Cornerbead: Use at outside corners, unless otherwise indicated.
 - b. Bullnose Bead: Use at outside corners.
 - c. LC Bead: Use at exposed panel edges.
 - d. L Bead: Use where indicated or necessary.
 - e. U Bead: Use at exposed panel edges.

- K. Gypsum Board Finishing: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
1. Pre-fill open joints, rounded or beveled edges, and damaged surface areas.
 2. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
 3. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - a. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - b. Level 2: Panels that are substrate for tile.
 - c. Level 3: Where indicated on Drawings.
 - d. Level 4: For surfaces receiving flat paints.
 - e. Level 5: For surfaces receiving gloss or semi-gloss paint, subjected to severe lighting, or receiving wall covering.
 4. Glass Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
 5. Glass Mat Faced Panels: Finish according to manufacturer's written instructions.
- L. Installation Tolerances:
1. Suspension System: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
 2. Installation Tolerances, Suspension System: Install suspension systems level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
- M. Fire-Resistance-Rated and Smoke Partitions Markings
1. Each fire-resistance rated partition, smoke partition, or other wall requiring protected openings is to be marked as such as defined below.
 - a. Location: Mark walls in accessible concealed floor, floor-ceiling, and attic spaces.
 - b. Spacing: Markings shall be located within 15 feet of the end of each wall and at intervals not exceeding 30 feet measured horizontally along the wall or partition.
 - c. Lettering: Stenciled letters a minimum of 3 inches in height with a minimum 3/8 inch stroke in a color contrasting with the wall material (typically black) paint. Markings shall be one of the following, appropriate to the partition type, as indicated on plans.
 - 1) "SMOKE PARTITION – PROTECT ALL OPENINGS".
 - 2) "#-HR FIRE BARRIER – PROTECT ALL OPENINGS" where #-HR is as indicated on the Drawings.
 - 3) "#-HR FIRE WALL – PROTECT ALL OPENINGS" where #-HR is as indicated on the Drawings.

3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 30 00 - TILING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Porcelain Tile.
- B. Related Sections:
 - 1. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
 - 2. Section 07 95 13 - Expansion Joint Cover Assemblies: Expansion joint components.
 - 3. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.3 REFERENCE STANDARDS

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017 (Reaffirmed 2022).
- B. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- C. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- D. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
- F. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2019).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
- K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
- L. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.
- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).

- N. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.
- O. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- P. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018.
- Q. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2023.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meeting: Convene a pre-installation meeting one week before starting work of this section; require attendance by affected installers.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches (457 by 457 mm) in size illustrating pattern, color variations, and grout joint size variations.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Master Grade Certificate: Submit for each type of tile, signed by the tile manufacturer and tile installer.
- G. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Porcelain Tile:
 - 2. Tile Setting and Grout Materials: Those manufactured by tile manufacturers named above or any of the following as approved by tile manufacturer for use with their tile and to suit application.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 TILE SCHEDULE

- A. Tile Type T-1 - Textured Wall Tile:
 1. Basis of Design:
 - a. Products manufacturer by Dal-Tile Corp.
 - b. Line: Modern Linear.
 - c. Color: White ML60.
 - d. Finish: Matte.
 2. Material: Porcelain.
 3. Size: 12 by 24 inches.
- B. Tile Type T-2 - Floor Tile:
 1. Basis of Design:
 - a. Products manufacturer by Dal-Tile Corp.
 - b. Line: Fixture.
 - c. Color: Glacier FX21.
 - d. Finish: Matte.
 2. Material: Porcelain.
 3. Size: 12 by 24 inches.
- C. Tile Type T-3 - Dark Blue Glass Accent:
 1. Basis of Design:
 - a. Products manufacturer by Dal-Tile Corp.
 - b. Line: Color Wave.
 - c. Color: Twilight Blue CW14.
 - d. Finish: Glossy.
 2. Material: Glass.
 3. Size: 2 by 12 inches.
- D. Tile Type T-4 - Light Blue Glass Accent:
 1. Basis of Design:
 - a. Products manufacturer by Dal-Tile Corp.
 - b. Line: Color Wave.
 - c. Color: Blue Lagoon CW13.
 - d. Finish: Glossy.
 2. Material: Glass.
 3. Size: 2 by 12 inches.
- E. Tile Type T-5 - Mosaic Tile:
 1. Basis of Design:
 - a. Products manufacturer by Dal-Tile Corp.
 - b. Line: Keystones.
 - c. Color: Suede Gray D182.
 - d. Finish: Textured.
 2. Material: Porcelain.
 3. Size: 2 by 2 inches, mesh mounted.
- F. Tile Type T-6 - Cove Tile Base:
 1. Basis of Design:
 - a. Products manufacturer by Dal-Tile Corp.
 - b. Line: Fixture.
 - c. Color: Glacier FX21.

- d. Finish: Matte.
- 2. Material: Porcelain.
- 3. Size: 6 by 12 inches.
- G. Tile Type T-7 - Cove Mosaic Tile Base:
 - 1. Basis of Design:
 - a. Products manufacturer by Dal-Tile Corp.
 - b. Line: Keystones.
 - c. Color: Suede Gray C182.
 - d. Finish: Textured.
 - 2. Material: Porcelain.
 - 3. Size: 2 by 2 inches, mesh mounted.

2.3 PORCELAIN TILE

- A. Composition: ANSI A137.1 standard grade.
- B. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
- C. Size: As scheduled.
- D. Thickness: Refer to Basis of Design product.
- E. Surface Finish: As scheduled.
- F. Color(s): As scheduled.

2.4 TRIM AND ACCESSORIES

- A. Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
 - 1. Manufacturers: Same as for tile.
- B. Metal Trim: Refer to Section 05 77 00 - Decorative Extruded Metal.
 - 1. Applications:

2.5 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.

2.6 GROUTS

- A. Provide setting and grout materials from same manufacturer.

2.7 MAINTENANCE MATERIALS

2.8 ACCESSORY MATERIALS

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
 - 2. Follow moisture and alkalinity remediation procedures in Section 09 05 61 - Common Work Results for Flooring Preparation.

3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.3 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control and expansion joints free of mortar, grout, and adhesive.
- I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- J. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 CLEANING

- A. Clean tile and grout surfaces.

3.5 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

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SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Suspended metal grid ceiling system.
 - 2. Suspended plastic grid ceiling system.
 - 3. Acoustical units.
 - 4. Supplementary acoustical insulation above ceiling.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Section 03 10 00 - Concrete Forming and Accessories: Placement of special anchors or inserts for suspension system.
 - 3. Section 03 30 00 - Cast-in-Place Concrete: Placement of special anchors or inserts for suspension system.
 - 4. Section 07 21 00 - Thermal Insulation; Acoustical insulation.
 - 5. Section 08 31 00 - Access Doors and Panels: Access panels.

1.3 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- E. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- G. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- H. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- I. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- K. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- L. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.
- M. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.

- N. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.
- O. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2021a.
- P. CHPS (HPPD) - High Performance Products Database; Current Edition at www.chps.net/.
- Q. ISO 14644-1 - Cleanrooms and associated controlled environments - Part 1: Classification of air cleanliness by particle concentration; 2015.
- R. ITS (DIR) - Directory of Listed Products; Current Edition.
- S. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.
- T. UL (FRD) - Fire Resistance Directory; Current Edition.
- U. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.
- V. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Evaluation Service Reports: Show compliance with specified requirements.
- E. Samples: Submit two samples 6 by 6 inch (150 by 150 mm) in size illustrating material and finish of acoustical units, including edge.
- F. Samples: Submit two samples each, 6 inches (150 mm) long, of suspension system main runner, cross runner, and perimeter molding.
- G. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- H. Designer's Qualification Statement.
- I. Manufacturer's Qualification Statement.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 5 percent of each type installed, to a minimum of one box of each..

1.6 QUALITY ASSURANCE

- A. Designer Qualifications for Seismic Design: Perform under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
- B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. Acoustic Panels:
 - a. Armstrong World Industries, Inc.: www.armstrongceilings.com.
 - b. Acoustic Ceiling Products, Inc.: www.acpideas.com.
 - c. Acoustics First Corporation: www.acousticsfirst.com.
 - d. CertainTeed Corporation: www.certainteed.com.
 - e. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
 - f. Nelson Industrial, Inc: www.nelsonii.com/arch.
 - g. TECHLITE: www.techlite.com.
 - h. USG Corporation: www.usg.com/ceilings.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Rating: Determined in accordance with test procedures in ASTM E119 and complying with the following:
1. UL (FRD) Assembly Design No. _____.
 2. ICC-ES Evaluation Report No. _____.
- B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
1. Local authorities having jurisdiction.
 2. ICC-ES Evaluation Report No. _____.

2.3 ACOUSTICAL UNITS

- A. General Requirements: ASTM E1264, Class A.
1. VOC Content: Refer to Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 2. VOC Content: Certified as Low Emission by one of the following:
 - a. Product listing in UL (GGG).
 - b. Product listing in CHPS (HPPD).
- B. Acoustical Ceiling Panels (ACP-1): Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Basis of Design:
 - a. CALLA Health Zone AirAssure manufactured by Armstrong World Industries, Inc.
 2. Classification: ASTM E1264 Type IV.
 - a. Form: 2, water felted.
 - b. Pattern: "E" - lightly textured..
 3. Size: 24 by 24 inches (610 by 610 mm).
 4. Thickness: 1 inch (25 mm).
 5. NRC: 0.80, determined in accordance with ASTM E1264.
 6. Articulation Class (AC): 170, determined in accordance with ASTM E1264.

7. Panel Edge: Square tegular.
 8. Color: As indicated on Drawings.
 9. Suspension System: As indicated on Drawings.
 10. Accessories:
 - a. Factory-gasketed edges.
- C. Acoustical Ceiling Panels (ACP-3): Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Basis of Design:
 - a. CALLA Shapes for DESIGNFLEX manufactured by Armstrong World Industries, Inc.
 2. Classification: ASTM E1264 Type IV.
 - a. Form: 2, water felted.
 - b. Pattern: "E" - lightly textured..
 3. Shapes and Sizes:
 - a. 60 degree Left Parallelogram 24 inch base.
 - b. 60 degree Right Parallelogram 24 inch base.
 - c. 60 degree Triangle 24 inch base.
 4. Thickness: 1 inch (25 mm).
 5. NRC: 0.80, determined in accordance with ASTM E1264.
 6. Ceiling Attenuation Class (CAC): 31 (minimum), determined in accordance with ASTM E1264.
 7. Panel Edge: Square Tegular.
 8. Color: As indicated on Drawings.
 9. Suspension System: As indicated on Drawings.
 10. Installation Pattern: FCSH 38.

2.4 SUSPENSION SYSTEM(S)

- A. Exposed Suspension System: Hot-dipped galvanized steel grid and cap.
1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 2. Profile: Tee; face width as indicated on Drawings.
 3. Finish: Baked enamel.

2.5 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application.
- D. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.
- E. Wood Veneer Panel Safety Clips: Galvanized 1-9/16 by 5-1/2 inch (40 by 139 mm) bent sheet metal clips screw anchored to back of adjacent panels and spanning over top of suspended tee grid.
1. Wire Ties: No. 12 galvanized wire.
- F. Perimeter Moldings: Same metal and finish as grid.
1. Size: As required for installation conditions and specified Seismic Design Category.
 2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
 3. Shadow Molding: Shaped to create a perimeter reveal.
 4. Channel Molding: U-shaped, for hold-down type installations.
 5. Gaskets For Perimeter Moldings: Closed-cell foam, factory-applied to molding.
 6. Acoustical Sealant For Perimeter Moldings: Non-hardening, non-skinning, for use in conjunction with suspended ceiling system.

- G. Metal Edge Trim for "Cloud" Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
 - 1. Trim Height: As indicated on Drawings.
 - 2. Finish: Baked enamel.
 - 3. Color: As indicated on Drawings.
- H. Ceiling Pockets with Prewired Raceway: UL 325 listed, extruded aluminum shade pocket with removable closure panel and acoustical unit support, for recess mounting in suspended acoustical or drywall ceilings; size and configuration as indicated on drawings.
 - 1. Designed to accommodate installation of motor control and wiring accessories within pocket.
- I. Acoustical Insulation: Refer to Section 07 21 00 - Thermal Insulation.
- J. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.2 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.
- C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.3 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- D. Locate system on room axis according to reflected plan.
- E. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Install in bed of acoustical sealant.
 - 2. Use longest practical lengths.
 - 3. Overlap and rivet corners.
- F. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- G. Seismic Suspension System, Seismic Design Category C: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Maintain a 3/8 inch (9 mm) clearance between grid ends and wall.
- H. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch (19 mm) clearance between grid ends and wall.
- I. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

- J. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- K. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.
- L. Do not eccentrically load system or induce rotation of runners.
- M. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch (25 mm) movement. Maintain visual closure.
- N. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

3.4 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units with pattern parallel to longest room axis.
- D. Fit border trim neatly against abutting surfaces.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.
- H. Lay acoustical insulation for a distance of 48 inches (1219 mm) either side of acoustical partitions as indicated.
- I. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
- J. Install hold-down clips on panels within 8 ft (2.5 m) of an exterior door.
- K. Install plastic lay-in panels at following minimum distance from conventional light sources:
 - 1. Halogen, 60 Watt: 14 inches (355 mm) minimum.
 - 2. Incandescent, 120 Watt: 15 inches (380 mm) minimum.
 - 3. Quartz Halogen, 500 Watt: 23 inches (584 mm) minimum.
 - 4. _____: _____ inch (_____ mm).
- L. Install safety clips on wood veneer panels 2 inches (51 mm) from outside edge of panel and at 24 inches (610 mm) on center.
 - 1. Use wire ties to attach safety clips.
- M. Install wood veneer trim using aluminum L angle to attach to suspended grid system as required for application.

3.5 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 64 66 - WOOD ATHLETIC FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Wood athletic flooring.
 - 2. Subflooring.
 - 3. Sleepers.
 - 4. Resilient cushioning.
 - 5. Sheet vapor retarder.
 - 6. Floor finishes.
 - 7. Surface finishing.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Section 03 30 00 - Cast-in-Place Concrete: Concrete subfloor surface; recessed.
 - 3. Section 03 30 00 - Cast-in-Place Concrete03 30 00 - Cast-in-Place Concrete: Formed depressions for deep floor sockets and inserts.
 - 4. Section 06 10 00 - Rough Carpentry: Subfloor blocking.
 - 5. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
 - 6. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
 - 7. Section 09 90 00 - Painting and Coating: Product requirements for surface finish materials for application in this section.
 - 8. Division 26 - Electrical: Electrical floor cover plates.

1.3 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- D. ASTM F2772 - Standard Specification for Athletic Performance Properties of Indoor Sports Floor Systems; 2011 (Reapproved 2019).
- E. DIN EN 14904 - Surfaces for Sports Areas – Indoor Surfaces for Multi-Sports Use – Specification; 2006.
- F. MFMA (PUR) - Performance and Uniformity Rating Sport Specific Standards; current edition.
- G. MFMA (SPEC) - Guide Specifications for Maple Flooring Systems; current edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.

- B. Product Data: Provide data for flooring, floor finish materials, and resilient cushion.
- C. Shop Drawings: Indicate floor joint pattern and termination details.
 - 1. Indicate provisions for expansion and contraction, wall base, and game insert or socket devices.
 - 2. Indicate size and type fasteners and anchors.
 - 3. Indicate location, size, design, and color of game markings.
- D. Samples: Submit two samples 3 by 3 inch in size showing floor finish, color, and sheen.
- E. Test Reports: Submit test reports showing compliance with DIN EN 14904.
- F. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- G. Manufacturer's Instructions: Indicate standard and special installation procedures.
- H. Maintenance Data: Include maintenance procedures and recommended maintenance materials.
- I. Manufacturer's qualification statement.
- J. Installer's qualification statement.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Flooring Material: 10 square yards (9 sq m) matching installed flooring.

1.6 QUALITY ASSURANCE

- A. Perform work of this section in accordance with MFMA (SPEC).
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.
 - 1. Minimum three years of documented experience.
 - 2. Member mill of the Maple Flooring Manufacturers Association, Inc (MFMA).
- C. Installer Qualifications: Company specializing in installing products specified in this section.
 - 1. Minimum three years of documented experience.
 - 2. MFMA accredited and approved by flooring manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Deliver materials and store off the floor in a well-ventilated, weather-tight space.

1.8 FIELD CONDITIONS

- A. Do not install wood flooring until wet construction work is complete and permanent heat and air conditioning is installed and operating.
- B. Maintain room temperature between 55 degrees F (13 degrees C) and 75 degrees F (24 degrees C) and relative humidity between 35 to 50 percent for a period of seven days prior to delivery of materials to installation space, during installation, and after installation.
- C. Acclimate wood flooring materials to installation space a minimum of 48 hours prior to installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Wood Athletic Flooring:

- a. Aacer Flooring: www.aacerflooring.com/#sle.
- b. Action Floor Systems: www.actionfloors.com/#sle.
- c. Connor Sports Flooring: www.connorfloor.com/#sle.
- d. Grid: www.builtbygrid.com/#sle.
- e. Robbins Sports Surfaces: www.robbinsfloor.com/#sle.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 WOOD ATHLETIC FLOORING

A. General: Wood athletic flooring, system components provided by single manufacturer.

1. Performance Stage System Description:
 - a. Fixed, cushioned sleeper system, wood strip flooring.

2.3 COMPONENTS

A. Wood Strip Flooring:

1. Provide MFMA grade-marked flooring, stamped as manufactured by MFMA member mill.
2. Species: Northern hard maple, kiln dried; tongue and groove edges, end matched.
3. Grade: First.
4. Cut: Edge grain.
5. Moisture Content: 7 to 9 percent.
6. Thickness: 25/32 inch (20 mm).
7. Width: 2-1/4 inches (57 mm).
8. Length: Random, minimum of 9 inches (230 mm).

B. Sleepers:

1. Length: 48 inches (1200 mm).
2. Softwood lumber, 2 by 4 inch (50 by 100 mm) nominal.
3. Plywood, 7/8 inch by 4 inch (22 mm by 100 mm) nominal.

C. Subflooring: Two layers of 1 by 6 inch (25 by 152 mm) nominal, softwood lumber.

D. Channels: Galvanized steel, manufacturer's standard size and shape for system indicated.

E. Resilient Cushioning: Manufacturer's standard rubber pads, factory-applied to bottom side of sleepers.

1. Thickness: ____ inch (____ mm).

F. Resilient Underlayment: Polyethylene foam sheet.

1. Thickness: ____ inch (____ mm)

G. Vapor Retarder: Polyethylene sheet, 6 mil (0.15 mm) thick; 2 inch (50 mm) wide tape for sealing sheet seams.

H. Fasteners and Anchors: Manufacturer's standard type and size to suit application.

2.4 FINISHES

2.5 ACCESSORIES

A. Ventilating Base: Molded rubber, ____ inch (____ mm) high with a ____ inch (____ mm) toe, pre-molded outside corners; black color.

B. Edge Strip: ____; ____ aluminum.

C. Transition Strip: Same species and finish as flooring material; profiles indicated.

D. Game Socket Devices: _____, with anchors.

E. Adhesives: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting this work.

- B. Verify that concrete subfloor surface is smooth and flat to plus or minus 1/4 inch in 10 feet (6 mm in 3 m).
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
 - 2. Follow moisture and alkalinity remediation procedures in Section 09 05 61 - Common Work Results for Flooring Preparation.
- D. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Prepare substrate to receive wood flooring in accordance with manufacturer's and MFMA instructions.
- B. Vacuum clean substrate.

3.3 INSTALLATION

- A. Place vapor retarder over concrete surface, overlap seams a minimum of 6 inches (150 mm) and seal with tape.
- B. Resilient Underlayment: Install in accordance with manufacturer's instructions.
- C. Sleepers with Plywood Subfloor:
 - 1. Place sleepers at 90 degree angle to direction of finished floor; space 12 inches (300 mm) on center. Stagger end joints a minimum of 24 inches (610 mm).
 - 2. Anchor sleepers to concrete substrate with steel anchoring pins.
 - 3. For floating applications, do not secure sleepers to structure.
 - 4. Fasten plywood subfloor over sleepers at 45 degree angle to direction of finished floor. Allow minimum 1/4 inch (6 mm) between plywood subfloor edges.
 - 5. Fasten solid lumber subfloor over sleepers at 45 degree angle to direction of finished floor; space as indicated on Drawings.
- D. Double Layer Solid Lumber Subfloor:
 - 1. Place first layer at 45 degree angle to direction of finished floor.
 - 2. Fasten second layer at 45 degree angle to first layer.
 - 3. Allow 1/4 inch (6 mm) at ends of subfloor and 2 inches (24 mm) between adjacent rows.
- E. Install solid blocking at doorways, under stacked bleachers, under locations of heavy equipment, and as shown on drawings, in accordance with flooring manufacturer's recommendations.
- F. Wood Flooring:
 - 1. Install in accordance with manufacturer's and MFMA instructions.
 - 2. Lay flooring parallel to length of main playing area. Blind nail or staple to subfloor.
 - 3. Install edge strips at unprotected or exposed edges, and where flooring terminates.
 - 4. Provide 2 inch (24 mm) expansion space at walls and other interruptions.
- G. Install base at floor perimeter to cover expansion space in accordance with manufacturer's instructions. Miter inside corners.
- H. Install floor sockets and inserts to a depth sufficient to ensure flush top surface with floor surface.
- I. Finishing:
 - 1. Mask off adjacent surfaces before beginning sanding.
 - 2. Sand flooring to smooth even finish with no evidence of sander marks. Remove dust by vacuum.
 - 3. Apply finishes in accordance with floor finish manufacturer's and MFMA instructions.

4. Apply one sealer coat and three finish coats.
5. Apply first coat, allow to dry, then buff lightly with recommended pad to remove irregularities. Vacuum clean and wipe with damp, lint-free cloth before applying succeeding coats.
6. Apply game lines/markers in accordance with layout indicated on drawings.
7. Apply last coat of finish.

3.4 CLEANING

- A. Clean floor surfaces in accordance with floor finish manufacturer's instructions.

3.5 PROTECTION

- A. Prohibit traffic on finished floor for 72 hours after installation.
- B. Place protective coverings over finished floors; do not remove coverings until Date of Substantial Completion.

END OF SECTION

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SECTION 09 65 00 - RESILIENT FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient sheet flooring.
 - 2. Resilient tile flooring
 - 3. Installation accessories.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Division 26: Electrical floor cover plates for installation of resilient flooring specified in this section.

1.3 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2019a, with Editorial Revision (2020).
- B. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile; 2020.
- C. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.
- D. NSF 332 - Sustainability Assessment for Resilient Floor Coverings; 2022.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plans and floor patterns.
- D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- E. Verification Samples: Submit two samples, 6 by 6 inch (150 by 150 mm) in size illustrating color and pattern for each resilient flooring product specified.
- F. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.
- G. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 78 23 - Operation and Maintenance Data for additional provisions.
 - 2. Extra Flooring Material: Provide extra flooring material equal to 1 percent of each type and color of installed flooring, minimum of 10 square feet (1 square meters).

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).
- D. Do not double stack pallets.

1.7 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution.

2.2 BASIS OF DESIGN

- A. Products as indicated on Drawings.

2.3 GENERAL REQUIREMENTS

- A. Unless noted otherwise, all Resilient Flooring shall comply with the following:
 - 1. VOC Content Limits: As specified in Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
 - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
 - 3. Surface Texture: As indicated on Drawings.
 - 4. Pattern: As indicated on Drawings.
 - 5. Color: As indicated on Drawings

2.4 RESILIENT SHEET FLOORING

2.5 RESILIENT TILE FLOORING

- A. General Requirements
 - 1. Size(s): As indicated on Drawings.
- B. Vinyl Tile - LVT-1 and LVT-2: Printed film type, with transparent or translucent wear layer.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. Armstrong Flooring: www.armstrongflooring.com/#sle.
 - b. Burke Flooring: www.burkeflooring.com/#sle.
 - c. Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
 - d. LG Hausys America, Inc.: www.lghausysusa.com/#sle.
 - e. Metroflor Corporation: www.aspectaflooring.com/#sle.
 - f. Roppe Corporation: www.roppe.com/#sle.
 - g. Shannon Specialty Floors, Inc.: www.shannonspecialtyfloors.com/#sle.
 - h. TAJ Flooring: www.tajflooring.com/#sle.

2. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
3. NSF 332 Certification: Platinum level.
4. Wear Layer Thickness: 0.020 inch (0.50 mm).
5. Total Thickness: 0.125 inch (3 mm).
6. Basis of Design: Products manufactured by Mohawk Group.
7. Texture: Embossed.
8. Pattern: Chromascope CO159
9. Color:
 - a. LVT-1: Patina Night 650.
 - b. LVT-2: Winter Mood 910.

2.6 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Adhesive for Vinyl and Rubber Flooring:
 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following:
- C. Moldings, Transition and Edge Strips: Refer to .
 1. Metal Moldings, Transition and Edge Strips: Refer to Section 05 77 00 - Decorative Extruded Metal.
 2. Resilient Moldings, Transition and Edge Strips: Refer to Section 09 65 13 - Resilient Base and Accessories.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. Clean substrate.
- E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.3 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- D. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
 2. Resilient Strips: Attach to substrate using adhesive.
- E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

- F. Install flooring in recessed floor access covers, maintaining floor pattern.

3.4 INSTALLATION - SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Cut sheet at seams in accordance with manufacturer's instructions.

3.5 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.6 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.7 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes
 - 1. Resilient base, adhesive attached, in locations shown on drawings.
 - 2. Resilient subfloor transitions.

1.3 REFERENCE STANDARDS

- A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to demonstrate compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Samples:
 - 1. Actual samples or color charts showing manufacturer's full range of colors, for Architect's selection (if selections are not already scheduled or otherwise indicated on the drawings).
 - 2. Actual 12-inch-long piece of base material in each color selected for approval.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed, whose product meets or exceeds the specifications are approved for use on the Project with Architect's approval. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Burke Flooring.
 - 2. Flexco.
 - 3. Johnsonite.
 - 4. Mannington.
 - 5. Nora Rubber Products.
 - 6. Roppe Corp.
 - 7. Tarkett.

2.2 MATERIALS

- A. Standard Rubber Base (typical except where extended toe or other type of base is specifically indicated on drawings, e.g., at athletic flooring or elsewhere) (RB-1):
 - 1. Quality Standard: ASTM F1861.
 - 2. Material: Rubber, vulcanized, Type TS, Group I, Styles A and B. Vinyl base and Type TP are not acceptable.
 - 3. Manufacturing Method: Group I (solid, homogeneous)
 - 4. Style: Topset cove; rolls of greatest length available, cut to length required to minimize joints.
 - 5. Minimum Thickness: Full 1/8 inch (3.2 mm)
 - 6. Color(s): As scheduled or otherwise indicated on the drawings, or if not so indicated, as selected by Architect.
 - 7. Height: 4 inches, unless indicated otherwise
 - 8. Corners: Job-Formed.

9. Basis of Design: Products as manufactured by Burke Flooring, Flexco, Johnsonite, Nora Rubber Products, or Roppe Corp.
- B. Extended (Sanitary) Toe Rubber Base (at athletic flooring or elsewhere, if and where indicated) (RB-2):
1. Quality Standard: Same as above
 2. Material: Rubber
 3. Type: Sanitary Cove with two (2) inch toe; 48 inch lengths
 4. Thickness: 1/8 inch thick with a 0.125 inch thick toe
 5. Color: As selected by Architect.
 6. Height: Four (4) inches
 7. Basis of Design: Extruded Rubber Cove Base with Sanitary Toe manufactured by Roppe Corp., or Architect approved equal.
- C. Decorative Rubber Base (RB-3):
1. Quality Standard: ASTM F1861.
 2. Material: Thermoplastic Rubber, Type TP, Group I, Style D
 3. Thickness: Full 0.25 (1/4) inch
 4. Color: As selected by Architect.
 5. Height: 4-1/4 inches
 6. Manufacturers: Burke Flooring, Flexco, Johnsonite, Mannington, Nora Rubber Products, Roppe Corp., or Architect approved equal.
 7. Basis of Design: "Captivate" as manufactured by Flexco.
- D. Joining and Edge Finish Moldings (TR-#):
1. Usage: For use at flooring terminations with other flooring
 2. Type: Tapered or bullnose edge, as required to provide juncture at edge of adjacent floor surfaces
 3. Size: One (1) inch wide by 1/8 inch thick or as applicable to the type of flooring and condition
 4. Material: Rubber or vinyl as recommended by manufacturer to suit application
 5. Color(s): As selected by the Architect.
 6. Manufacturers: Burke Flooring, Flexco, Johnsonite, Roppe, Tarkett, or Architect approved equal.
 7. Transition Type:
 - a. Snap Down "T" (TR-1): Snap-in "T" molding joining 1/4 or 5/16 inch material on each side.
 - 1) Basis of Design: "Transitional Moldings 930" as manufactured by Mannington.
 - 2) Accessories: 970, 980, or 990 track.
 - 3) Color(s): As selected by the Architect.
 - b. Tile Carpet Joiner (TR-2): One-piece molding joining 1/4 inch carpet to 1/4 inch tile
 - 1) Basis of Design: "Transitional Moldings 150" as manufactured by Mannington.
 - 2) Color(s): As selected by the Architect.
 - c. Underslung Reducer (TR-3): Binder bar edging for 1/16 inch to 1/8 inch resilient floors with dry back.
 - 1) Basis of Design: "Transitional Moldings 735" as manufactured by Mannington.
 - 2) Color(s): As selected by the Architect.
- E. Stair Treads (RS-1):
1. Usage: For use at interior stairs, as indicated on Drawings
 2. Type: Stair treads for the visually impaired..
 3. Thickness: 1/8 inch.
 4. Size: Largest sizes available as required for installation.
 5. Material: Rubber or vinyl as recommended by manufacturer to suit application.
 6. Color(s): As selected by the Architect.

7. Manufacturers: Burke Flooring, Flexco, Johnsonite, Mohawk, Roppe, Tarkett, or Architect approved equal.
 8. Basis of Design: Mohawk "TRUE" Stair Treads
- F. Resilient Nosing (RN-1):
1. Usage: For use at interior stairs, as indicated on Drawings.
 2. Type: Linear Stair Nosing.
 3. Thickness: 1/8 inch at tread.
 4. Material: Rubber or vinyl as recommended by manufacturer to suit application
 5. Color(s): As selected by Architect.
 6. Manufacturers: Burke Flooring, Flexco, Johnsonite, Mannington Commercial, Mohawk, Roppe, Tarkett, or Architect approved equal.
 7. Basis of Design: Model 565 "Double Undercut Carpet Stair" as manufactured by Mannington Commercial.
- G. Resilient Subfloor Transition (RST):
1. Usage: Subfloor Transition System.
 2. Thickness: Varies, cut to length.
 3. Material: Rubber or vinyl as recommended by manufacturer to suit application
 4. Basis of Design: "The Equalizer Transition" as manufactured by Mannington Commercial.
- H. Adhesive: Rubber-based type; same brand as base or as recommended and approved by base manufacturer to suit application.
- I. Other Materials: Provide other materials, not specifically described but required for a complete and proper installation.

2.3 EXTRA STOCK

- A. Deliver to Owner:
1. percent, or one (1) unopened carton of each color, type and size of base selected, whichever is greater.
 2. One (1) gallon container of each type adhesive used for base.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which Work of this Section will be performed. Report unsatisfactory conditions to Architect in writing. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Prepare substrates to receive base as recommended by base manufacturer.
- B. Verify substrates are smooth and ready to receive resilient base. Grind high spots and fill low spots with latex cementitious filler as required.
- C. Starting Work indicates acceptance of existing conditions.

3.3 INSTALLATION

- A. General:
1. Install materials only after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating.
 2. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommended by the manufacturers of the materials used.
- B. Installing Base:
1. Install base where shown on the Drawings in accordance with manufacturer's instructions.
 2. Use factory-preformed exterior corners, and factory preformed or job-mitered interior corners, as indicated on the drawings or directed by Architect.

3.4 CLEANING AND PROTECTING

- A. Remove excess adhesive and other blemishes from exposed surfaces, using neutral cleaner recommended by the manufacturer of the resilient materials.

END OF SECTION

SECTION 09 66 23.16 - EPOXY-RESIN TERRAZZO FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Requirements including, but not limited to, the following:
 - 1. Epoxy terrazzo with divider and accessory strips.
 - 2. Precast terrazzo units.

1.3 DEFINITIONS

- A. NTMA: National Terrazzo and Mosaic Association, Inc.

1.4 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: The Contractor shall conduct a conference at project site before Terrazzo Contractor begins installation.
 - 1. The Contractor shall invite Terrazzo Contractor, the Architect and representatives of the Owner.
 - 2. Review methods and procedures related to terrazzo including, but not limited to, the following:
 - a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
 - b. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
 - c. Review terrazzo mixes and patterns.
 - d. Review custom terrazzo mixes, designs and patterns.
 - e. Coordination with the work of other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: Terrazzo Contractor shall submit Product Data for each type of product required for installation including:
 - 1. Strip materials.
 - 2. Sealer.
- B. Shop Drawings: Terrazzo Contractor shall prepare and submit Shop Drawings that include plans, elevations, sections, component details and attachments to other work. Include terrazzo installation requirements. Show layout of the following:
 - 1. Divider strips.
 - 2. Expansion joint strips.
 - 3. Accessory strips.
 - 4. Abrasive strips.
 - 5. Stair treads, risers and landings.
 - 6. Terrazzo patterns.
- C. Samples:
 - 1. Terrazzo Contractor shall prepare and submit a maximum of three samples, sizes 6 by 6 inches for each color and type of terrazzo specified.
 - 2. Terrazzo Contractor shall submit three samples, sizes 6 by 6 inches for each color and type of precast terrazzo specified.
- D. Samples for Initial Selection: Terrazzo Contractor shall submit NTMA "Color Palette Brochure" showing full range of colors and patterns available for each terrazzo type.

- E. Samples for Verification: Terrazzo Contractor shall prepare and submit samples for each type, material, color and pattern of terrazzo and accessory required showing the full range of color, texture and pattern variations expected.
 - 1. Terrazzo: 6 by 6 inch samples.
 - 2. Accessories: 6 inch long Samples of each type and kind of exposed strip item required.
 - 3. Precast Terrazzo Units: Samples, sizes 6 by 6 inches for each color and type of precast terrazzo specified.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Terrazzo Contractor shall submit two copies of qualification data.
 - 1. Include list of projects indicating name and location of project, name of Owner, name and contact information for Contractor, and name and contact information for Architect.
 - 2. Include letter from NTMA with the name of the Project and name of member, stating current member status.
- B. Material Certificates:
 - 1. Epoxy Resin: For each type of resin required indicating that materials meet specification requirements, by manufacturer.
 - 2. Aggregate: For each type of aggregate required indicating compatibility with terrazzo mix, signed by aggregate supplier.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Literature: Terrazzo Contractor shall submit two copies of maintenance recommendations from NTMA.

1.8 QUALITY ASSURANCE

- A. Epoxy Resin Manufacturer: An Associate Member of the NTMA, experienced in manufacturing epoxy resin in accordance with NTMA standards and with a record of successful in-service performance as well as sufficient production capacity to produce required materials.
- B. Terrazzo Contractor: A Contractor Member of NTMA whose work has resulted in construction with a record of successful in-service performance.
 - 1. Installer shall have completed terrazzo installations within the past 5 years of scale and complexity similar to the proposed installation.
- C. Source Limitations for Aggregates: Terrazzo Contractor shall obtain each color, grade, type and variety of granular materials from sources with resources to provide materials of consistent quality in appearance and physical properties.
- D. Mockups: Terrazzo Contractor shall construct mockup if required in bid or scope of work documents to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup as indicated on Drawings.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to Project site in supplier's original wrappings and containers, labeled with source or manufacturer's name, material or product brand name, and lot number if any.
- B. Materials shall be stored in their original, undamaged packages and containers, in a location where they will not be exposed to direct sunlight.
 - 1. Epoxy components shall be stored in a space where the ambient temperature can be maintained 60 and 90 degrees F before use.

1.10 PROJECT CONDITIONS

- A. Contractor shall provide sufficient water, temporary heat and light, and adequate electric power with suitable outlets connected and distributed for use within 100 feet of any working space.
- B. Contractor shall provide temporary enclosures and other suitable methods to protect adjacent spaces from damage during installation.
 - 1. Maintain ambient temperatures in the area to receive terrazzo at not less than 60 degrees F.
 - 2. Maintain adequate ventilation in the area to receive terrazzo.
- C. Terrazzo Contractor shall protect other adjacent work from water and dust generated by grinding operations.

1.11 WARRANTY

- A. One year from date of substantial completion of terrazzo installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. Manufacturers listed, whose product meets or exceeds the specifications are approved for use on the Project with Architect's approval. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
- B. Basis-of-Design: Provide custom mix to match existing; manufacturer to be Venice Art Terrazzo Company; www.veniceartterrazzo.com/#sle.
- C. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 PERFORMANCE

- A. Epoxy Resin:
 - 1. Test Specimens: Mix resin materials according to manufacturer's recommendation without aggregate added and cure for 7 days at 75 degrees plus or minus 2 degrees F and 50 percent plus / minus 2 percent relative humidity.
 - 2. Cured test specimens shall meet or exceed the following requirements:
 - a. Hardness: 60 to 85 per ASTM D 2240, Shore D.
 - b. Minimum Tensile Strength: 3000 psi per ASTM D 638 for a 2-inch specimen made using a "C" die per ASTM D 412.
 - c. Minimum Compressive Strength: 10,000 psi per ASTM D 695, Specimen B cylinder.
 - d. Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
 - 1) Distilled Water.
 - 2) Mineral Water.
 - 3) Isopropanol.
 - 4) Ethanol.
 - 5) Soap solution at 1 percent.
 - 6) Sodium hydroxide at 10 percent solution.
 - 7) Hydrochloric acid at 10 percent solution.
 - 8) Hydrochloric acid at 30 percent solution.
 - 9) Detergent Solution at 0.025.
 - 10) Acetic Acid at 5 percent solution.
- B. Epoxy Resin with Aggregate:
 - 1. Test Specimens:
 - a. Mix epoxy resin according to manufacturer's recommendations and blend one volume of epoxy resin with 3 volumes of marble aggregate, consisting of:
 - 1) 60 percent No. 1 chip.

- 2) 40 percent No. 0 chip.
- b. Grind and grout with epoxy resin finished to a nominal 1/4 inch thickness.
- c. Cure specimens 7 days at 75 deg. F plus / minus 2 deg. and 50 percent plus / minus 2 percent relative humidity.
2. Cured epoxy terrazzo specimens shall nominally meet the following requirements:
 - a. Flammability: Self-extinguishing, extent of burning 1/4 inch maximum according to ASTM D 635.
 - b. Coefficient of Linear Thermal Expansion: 0.0025 inch/inch per deg F for temperature range of minus 12 to plus 140 deg F per ASTM D 696.
- C. Bond Strength of Epoxy Terrazzo: 300 lb. failure according to field test method for surface soundness and adhesion as described in ACI Committee No. 403 Bulletin.

2.3 MATERIALS

- A. Epoxy Resin Matrix: Two-component, high solids product complying with specified performance requirements.
 1. Color: As required for mix indicated.
- B. Primer: As recommended, manufactured and supplied by epoxy resin manufacturer.
- C. Aggregates:
 1. Comply with NTMA gradation standards.
 2. Abrasion and Impact Resistance: Loss of 40 percent or less when tested according to ASTM C 131 (LA Abrasion).
 3. Aggregates shall contain no deleterious or foreign matter.
- D. Divider Strips:
 1. Material: Match existing.
 2. Strip Thickness: 16 gauge.
 3. Type: "L" strip: 3/8 inch by 1/2 inch.
 4. Heavy Top Thickness: 1/8 inch.

2.4 MISCELLANEOUS ACCESSORIES

- A. Sealer: Terrazzo Contractor shall provide a non-ambering, clear sealer that is chemically neutral; does not impair terrazzo aesthetics or physical properties; is recommended by terrazzo matrix manufacturer. Sealers shall comply with the following:
 1. Comply with requirements of authorities having jurisdiction.
 2. Comply with ASTM D 2047.
 3. Water Based Sealer Properties: With pH factor between 7 and 10.
 4. Solvent Based Sealer Properties: Flashpoint at 80 degrees F or above according to ASTM D 56.
- B. Moisture Mitigation: Two-component, high solids, moisture tolerant, high density, low odor, epoxy-based product produced by epoxy terrazzo resin manufacturer specifically recommended to reduce alkalinity levels and moisture emission to acceptable levels. < If required, shall be an extra cost to others >.
- C. Crack Suppression/Isolation Membrane: As recommended, produced and supplied by approved terrazzo resin formulator, having minimum 120 percent elongation potential per ASTM D 412. .

2.5 MIXES

- A. Terrazzo Selection: Terrazzo Contractor shall provide standard terrazzo mix(es) according to the following:
 1. NTMA Plate No.: Match existing.
 2. Mix Color: Match existing.
- B. Proportions for Epoxy Terrazzo Topping: Comply with resin supplier's recommendations.

- C. Mixing of Terrazzo Topping: Mix epoxy components with aggregates in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.1 EXAMINATION

- A. The Contractor and Architect shall examine substrates and areas, with Terrazzo Contractor present, for compliance with requirements for installation tolerances and other conditions affecting performance of the work.
 - 1. Slab Flatness Tolerance: Subfloor is not to vary more than 1/4 inch from true plane in a 10 foot span.
 - 2. Cracks: Locate cracks and joints in concrete substrates. Verify location of control joints and expansion joints in epoxy terrazzo flooring.
 - a. If required to prevent cracks in concrete substrates transmitting through epoxy terrazzo flooring, the Terrazzo Contractor shall make a written recommendation to install a crack suppression membrane and include specific recommendations on type and location.
- B. The Contractor shall retain the services of an independent testing laboratory to verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to epoxy resin manufacturer's written instructions.
 - 1. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - 2. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lbs. of water/1000 sq. ft. of slab area in 24 hours.
 - 3. If required to prevent moisture vapor transmission in concrete substrates, the Terrazzo Contractor shall make a written recommendation to install moisture mitigation materials and include specific recommendations on type and location.
- C. The Contractor shall be responsible for correcting non-conforming concrete substrates using materials compatible with epoxy terrazzo flooring system and as approved by the Terrazzo Contractor.
 - 1. Materials used to correct nonconforming conditions must be compatible with the selected epoxy system and be approved by the manufacturer of epoxy resin materials and Terrazzo Contractor.
- D. Terrazzo Contractor shall proceed with installation only after unsatisfactory conditions, including levelness tolerances, cracking, excessive moisture vapor transmission, and alkalinity have been corrected.

3.2 PREPARATION

- A. Contractor shall broom clean area to receive terrazzo to remove loose chips and all foreign matter.
- B. Terrazzo Contractor shall mechanically abrade concrete surface.
 - 1. Terrazzo Contractor shall provide moisture mitigation materials according to instructions and recommendations of moisture mitigation materials manufacturer. Cost for moisture mitigation materials and installation shall be .
- C. Terrazzo Contractor shall provide flexible epoxy crack isolation/suppression membrane: Cost for materials and installation for installation over not more than five percent of the floor area receiving epoxy terrazzo shall be included in the Base Bid. Cost for additional materials and installation for installation .

3.3 POURED-IN-PLACE TERRAZZO INSTALLATION

- A. Strip Materials: Terrazzo Contractor shall install strip materials as follows:

1. Divider and Control-Joint Strips:
 - a. Locate divider strips in locations indicated.
 - b. Install control joint strips back to back in locations indicated.
 - c. Install strips in epoxy adhesive without voids below strips.
 - d. Accessory Strips: Install as required to provide a complete installation.
- B. Placing Terrazzo:
 1. Prime subfloor in accordance with manufacturer's recommendations.
 2. Proportion and thoroughly blend the materials.
 3. Place mixture to achieve specified thickness.
 4. Abrasive Strips: Install with surface of abrasive strip positioned 1/16 inch higher than terrazzo surface.
- C. Poured in Place Terrazzo Base: Terrazzo Contractor shall provide mix color for terrazzo base to match.
 1. Terrazzo Contractor shall place and finish terrazzo base at the same time the terrazzo floor is being installed.
- D. Finishing: Terrazzo Contractor shall finish the terrazzo topping as follows:
 1. Rough Grinding:
 - a. Grind with 24 or finer grit stones or with comparable diamond abrasives.
 - b. Follow initial grind with 60/80 grit stones or with comparable diamond abrasives.
 2. Grouting:
 - a. Clean terrazzo with clean water and rinse. Allow to dry.
 - b. Apply epoxy grout per manufacturer's instructions.
 - c. Allow grout to cure.
 3. Fine Grinding/Polishing: Grind with 120 grit or with comparable diamond abrasives until all grout is removed from surface.
- E. Terrazzo Cleaning: Terrazzo Contractor shall clean finished terrazzo as follows:
 1. Remove grinding residue from terrazzo surface.
 2. Wash terrazzo surfaces immediately after final grinding of terrazzo flooring with water and allow surfaces to dry thoroughly.
- F. Sealing: Terrazzo Contractor shall seal terrazzo according to sealer manufacturer's written instructions.

3.4 PRECAST TERRAZZO INSTALLATION

- A. Terrazzo Contractor shall install precast terrazzo units as follows:
- B. Precast Terrazzo Base: Use to install precast terrazzo base over substrates indicated according to .
- C. Precast Terrazzo Stair Units: Use over concrete substrates according to .
- D. Precast Terrazzo Stair Units: Use epoxy adhesive to install over steel substrates according to ANSI 108.6.

3.5 REPAIR

- A. Terrazzo Contractor shall repair terrazzo areas that evidence lack of bond between topping and underbed according to NTMA's written recommendations.

3.6 PROTECTION

- A. After application of the sealer, the Work shall be ready for final inspection and acceptance by the Owner or his agent.
- B. The Contractor shall protect the finished floor after the Terrazzo Contractor has completed final grinding and applied sealer to terrazzo surfaces.

END OF SECTION

SECTION 09 68 00 - CARPETING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements including but not limited to:
 - 1. Carpet and pad.
 - 2. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete.
 - 2. Section 09 65 13 - Resilient Base and Accessories.

1.3 REFERENCE STANDARDS

- A. ASTM D1335 - Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings; 2021.
- B. ASTM D2646 - Standard Guide for Backing Fabric Characteristics of Pile Yarn Floor Coverings; 2018.
- C. ASTM D3936 - Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering; 2021.
- D. ASTM D7330 - Standard Test Method for Assessment of Surface Appearance Change in Pile Floor Coverings Using Standard Reference Scales; 2022.
- E. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- F. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- G. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

1.4 PERFORMANCE REQUIREMENTS

1.5 SUBMITTALS

- A. Product Data - Technical data including installation recommendations for each type of substrate:
 - 1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
- B. Samples - For each products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules:
 - 1. Carpet: 12 inch (300 mm) square Sample from approved color and product of carpet.
 - 2. Carpet Seam: 6 inch (150 mm) Sample.
 - 3. Mitered Carpet Border Seam: 12 inch (300 mm) square Sample. Show carpet pattern alignment.
 - 4. Carpet accessory samples.
- C. Product Test Reports: For carpet and carpet cushion, for tests performed by a qualified testing agency.
- D. Shop Drawings: Showing extent of product, seam direction, and location and type of carpet accessories. Submittal to indicate columns, doorways, enclosing walls or partitions, casework, and locations where cutouts are required.

- E. Maintenance Data - For carpet to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet and carpet cushion.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Fire Test Response Characteristics: Provide products with the critical radiant flux classification determined by testing identical products in accordance with ASTM E648. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
 - 2. Accessibility Requirements - Comply with applicable requirements:
 - a. Americans with Disabilities Act of 1990, as amended:
 - 1) ADA Title II Regulations & the 2010 ADA Standards for Accessible Design
 - 2) 2010 ADA regulations.
 - b. CBC 2019 California Building Code (CCR Title 24, Part 2, as adopted and amended by DSA):
 - 1) CBC Chapter 11B, Access to Public Buildings, Public Accommodations, Commercial Buildings and Public Housing.
 - 3. AQMD - Air Quality Management District, Local Regulations.
 - 4. SCAQMD – South Coast Air Quality Management District Regulations Rule 1168 Adhesive and Sealant Applications.
 - 5. CRI – Carpet and Rug Institute Green Label Plus.
 - 6. Carpet shall have level loop, textured loop, or level-cut/uncutpile texture, firm cushion, pad or backing (or no cushion or pad) and maximum pile height of 1/2 inch in accordance with CBC Section 11B-302.2. Carpet edges shall comply with CBC 11B-302.2 and carpet trim to CBC Section 11B-303.
- B. Installer Qualifications: Installer having minimum 5 years' documented experience as a commercial carpet installer, who is certified by the International Certified Floorcovering Installers Association at the Commercial II or higher certification level.
- C. Contractor is required to achieve the specified concrete moisture content prior to installation of all flooring materials or use a flooring manufacture approved moisture barrier prior to installation of all flooring products.
- D. Pre-installation Conference:
 - 1. Refer to Section 01 31 00 - Project Management and Coordination.

1.7 WARRANTY

- A. Written warranty in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period:
 - 1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excessive surface wear, excess static discharge, and delamination.
 - 3. Warranty Period: 25 years from date of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.
- B. Store in a dry location between 65 degrees F and 90 degrees F and a relative humidity below 65%. Protect from damage and soiling. Stack carpet rolls horizontally, elevated above slab level on a flat surface, stacked no higher than two rolls.
- C. Store materials in area of installation for minimum period of 48 hours prior to installation.

- D. Protect carpet from damage, dirt, stains, and moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
1. Bentley Mills: www.bentleymills.com.
 2. Interface, Inc.: www.interface.com.
 3. Mannington Commercial, a part of Mannington Mills, Inc.:
www.manningtoncommercial.com.
 4. Milliken: www.milliken.com.
 5. Mohawk Industries: www.mohawkflooring.com.
 6. Patcraft: www.patcraft.com.
 7. ShawContract, part of Shaw Industries Group, Inc., a Berkshire Hathaway Company:
www.shawcontract.com.
 8. Tandus-Centiva, a Tarkett Company: commercial.tarkett.com.
 9. Tarkett: commercial.tarkett.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 CARPET, GENERAL

- A. Performance:
1. Appearance Retention Rating: Severe traffic, 3.5 minimum according to ASTM D7330.
 2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
 3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
 4. Delamination: Not less than 4 lbf/in. (18 N/mm) per ASTM D3936.
 5. Tuft Bind: Not less than 5 lbf (22 N) according to ASTM D1335.
 6. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC TM165.
 7. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC TM16, Option E.
 8. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria; not less than 1-mm halo of inhibition for gram-negative bacteria; no fungal growth; per AATCC TM174.
 9. Electrostatic Propensity: Less than 3.5 kV according to AATCC TM134.
 10. Emissions: Provide carpet that complies with testing and product requirements of CRI Green Label Plus.
 11. Backing: Standard with manufacturer.

2.3 TILE CARPETING

- A. Tile Carpeting, Type CPT-1 - Dark Gray:
1. Basis of Design: Products manufactured by Mannington Commercial .
 - a. Collection: Cross Talk.
 - b. Color: Screen Burn 15404.
 2. Size: 24 by 24 inches.
- B. Tile Carpeting, Type CPT-2 - Dark Blue:
1. Basis of Design: Products manufactured by Mohawk Group .
 - a. Collection: Line D GT477.
 - b. Color: Royal 545.
 2. Size: 12 by 36 inches.

2.4 ACCESSORIES

- A. Adhesives: Water resistant, mildew resistant, nonstaining, pressure sensitive type to suit products and subfloor conditions indicated, complying with flammability requirements for installed carpet and is recommended by carpet manufacturer for releasable installation.
- B. Trowelable Leveling and Patching Compounds: Latex modified, hydraulic cement based formulation provided or recommended by carpet cushion manufacturer.
- C. Adhesives: Water resistant, mildew resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet and carpet cushion manufacturers.
- D. Seam Adhesive: Hot melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- E. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints and provide accessible transitions. (11B-302)
- F. Extra Carpet: After completion of the carpet installation, the carpet subcontractor shall provide an additional three (3) percent of total yards installed of each carpet specified to the Owner for future carpet replacement that may be required. This extra stock is to be unused rolls, tiles, and mats and does not include scraps.

PART 3 EXECUTION

3.1 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet and carpet cushion until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet and carpet cushion over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

3.2 COORDINATION

- A. Contractor's responsibility to hire movers to move furniture as required for flooring installation. Coordinate with Owner and Architect regarding temporary furniture relocation.

3.3 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Concrete Subfloors -Verify that concrete slabs comply with ASTM F710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond.
 - 2. Prior to delivery of flooring materials, contractor shall conduct Calcium Chloride "dome" test to verify that concrete floors are dry with maximum moisture vapor emissions of 3 lbs. per 1000 square feet. in 24 hours, and exhibit negative alkalinity, carbonation or dusting. Apply moisture test in four (4) different areas of each floor location with at least one test for each 1,000 square feet of floor area.
 - 3. Prior to delivery of carpeting, conduct Relative Humidity Test Method in accordance with ASTM F2170 using a Wagner Rapid RH probe to verify relative humidity and surface pH

of concrete floor slabs, the method:

- a. Requires drilling holes at diameter not to exceed outside diameter of probe by more than 0.04 inch to depth equal to 40 percent of slab's thickness (elevated structural slab shall be tested at depth equal to 20 percent of slab thickness).
 - b. Place probe to full depth of test hole, place cap over probe.
 - c. Permit test site to acclimate, or equilibrate, for 72 hours prior to taking relative humidity readings.
 - d. Remove cap and press button on the probe to obtain reading.
 - e. Relative humidity readings for substrates receiving non-permeable flooring are 75% or lower.
4. Testing shall require 3 tests in first 1,000 square feet, with one additional test per each additional 1,000 square feet of concrete slab surface.
 5. Alkalinity Testing: Concrete floors shall be tested for alkalinity prior to installation of flooring. Levels of pH shall not exceed written recommendations of flooring manufacturer or adhesive manufacturer, or both.
 6. Delivery of flooring materials and beginning of installation means acceptance of existing substrate and site conditions.
 7. Subfloor finishes comply with requirements specified in Section 03 30 00 - Cast-In-Place Concrete for slabs receiving carpet.
 8. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
 9. Install Vapor Emission Treatment Systems where tests reveal presence of more than acceptable moisture level in accordance with Test Method ASTM F1869 or ASTM F2170.
- C. Proceed with installation after correcting unsatisfactory conditions.

3.4 PREPARATION

- A. Comply with CRI 104, Section 7.3 Site Conditions; Floor Preparation and with carpet manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet and cushion manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.5 INSTALLATION

- A. Comply with CRI 104 and carpet and carpet cushion manufacturer written installation instructions for the following:
 1. Direct Glue Down Installation: Comply with CRI 104, Section 9 Direct Glue Down Installation.
 2. Stair Installation: Comply with CRI 104, Section 13 Carpet on Stairs for glue down installation.
- B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position:
 1. Do not bridge building expansion joints with carpet.
 2. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
 3. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

- C. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- D. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, Patterned Carpet Installations and with carpet manufacturer's written recommendations.
- E. Install in accordance with CBC Section 11B-302.2

3.6 CLEANING AND PROTECTING

- A. Perform cleaning operations immediately after installing carpet:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
 - 2. Remove yarns that protrude from carpet surface.
 - 3. Vacuum carpet using commercial machine with face beater element.
- B. Protect installed carpet to comply with CRI 104, Section 16, Protecting Indoor Installations.
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet cushion manufacturer

END OF SECTION

SECTION 09 81 00 - ACOUSTIC INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fiberglass batt acoustical insulation.
 - 2. Sprayed cellulose fiber acoustical insulation.
- B. Related Sections:
 - 1. Section 09 21 16 - Gypsum Board Assemblies: Acoustically-rated partitions.
 - 2. Section 09 90 00 - Painting and Coating: Painting of spray-applied acoustic insulation.

1.3 REFERENCE STANDARDS

- A. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. ASTM E605/E605M - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 2019 (Reapproved 2023).
- D. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members; 2019 (Reapproved 2023).
- E. ASTM E759/E759M - Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).

1.4 SYSTEMS DESCRIPTION

- A. Contractor must use a total system, encompassing equipment, fiber and adhesive as supplied and tested by the manufacturer. No substitution.
- B. Fibers supplied under this Section shall have each bag coded with the date and lot number of manufactures and retained samples shall be kept by the manufacturer for not less than 1 year.
- C. Contractor must be licensed and trained by the manufacturer.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Certification:
 - 1. Manufacturer's certificate that the product meets or exceeds specified requirements.
 - 2. Manufacturer's written certification that product contains no asbestos, and that sprayed-cellulose fiber acoustical insulation contains no fiberglass or other man made mineral fibers.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturers.
 - 2. Suppliers.
 - 3. Installers/Applicators.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered in original, unopened containers bearing name of manufacturer, product identification and reference to U.L. testing.
- B. Store materials off ground, under cover and away from damp surfaces and keep material dry at all times.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Specifications are based on products of manufacturers named as the Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use on the Project. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Batt Insulation:
 - a. CertainTeed Corp.
 - b. Guardian Fiberglass, Inc.
 - c. Johns-Manville.
 - d. Knauf: knauf.com/.
 - e. Owens-Corning.
 - f. Thermafiber Sound Attenuation Fire Blanket.
 - 2. Spray-Applied Acoustic Insulation:
 - a. International Cellulose Corporation.
 - b. Monoglass.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 MATERIALS

- A. Acoustic Glass Batt Insulation for Use in Partitions and Over Acoustical Panel Ceilings:
 - 1. Basis of Design:
 - a. CertaPro AcoustaTherm manufactured by CertainTeed Corp.
 - b. Thermal & Sound Control Batts manufactured by Guardian Fiberglass, Inc.
 - c. Sound-SHIELD Sound Control Batts manufactured by Johns-Manville.
 - d. EcoBatt with ECOSE manufactured by Knauf.
 - e. Sonobatts (above ceiling) and Sound Batt (partitions) manufactured by Owens-Corning.
 - f. SAFB manufactured by Thermafiber Sound Attenuation Fire Blanket.
 - 2. Surface Burning Characteristics per ASTM E84:
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
 - 3. Thickness (minimum):
 - a. 3-1/2 inches where indicated on Drawings.
 - b. 6 inches above Acoustic Ceiling Systems as indicated on Drawings.
- B. Spray-Applied Acoustic Insulation:
 - 1. Color: Black, unless noted otherwise.
 - 2. Field-tested bond strength report per ASTM E736/E736M: Tested at over 5 years / Not less than 400 psf / Not less than 600 times its weight at one (1) inch
 - 3. Fire Resistance per ASTM E84: Tested at a minimum of five (5) inch thickness, Class I
 - a. Flame Spread: Not To Exceed Five (5).
 - b. Smoke Development: Not To Exceed Five (5).
 - 4. Sprayed insulation shall meet appropriate Building Code Requirements.
 - 5. Thickness: 2 inches minimum typical. Thickness shall be determined in accordance with ASTM E605/E605M field test procedure.

6. Bond Deflection per ASTM E759/E759M: 6 inch deflection in 10 foot span - no spalling or delamination.
7. Cohesive Strength at time of application per Method WS-2000: >700 Grams.
8. Basis of Design: "K-13 Spray-On-Systems" manufactured by International Cellulose Corporation.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine all surfaces and report all unsatisfactory conditions in writing to Architect. The work shall not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Provide masking, drop cloths or other satisfactory coverings for all materials/surfaces, which are not to receive insulation to prevent damage from over-spray.
- B. Surfaces to receive spray insulation shall be inspected prior to application to determine if priming/sealing is required to insure bonding and/or to prevent discoloration caused by migratory stains. Prime accordingly.
- C. Work shall be coordinated with other trades whose work may be affected or have an effect on the installation of the sprayed cellulose fiber.

3.3 INSTALLATION

- A. Installation, clean up and curing shall be accomplished according to the manufacturer's recommendations and common construction standards.
- B. Provide natural or mechanical ventilation continuously to properly cure the insulation.

3.4 PROTECTION

- A. Protect finished installation from damage caused by work of other trades.

END OF SECTION

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SECTION 09 84 00 - ACOUSTIC ROOM COMPONENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fabric-covered acoustic room components.
 - 2. Wood-faced acoustic room components.
 - 3. Pre-assembled wood panels.
 - 4. Cementitious wood fiber panels
 - 5. Pre-formed canopy components.
 - 6. Speaker cloth.
- B. Related Sections:
 - 1. Section 05 50 00 - Metal Fabrications: Miscellaneous metal supports.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.3 REFERENCES

- A. ASTM C365/C365M - Standard Test Method for Flatwise Compressive Properties of Sandwich Cores; 2022.
- B. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- D. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. ASTM E1111/E1111M - Standard Test Method for Measuring the Interzone Attenuation of Open Office Components; 2014 (Reapproved 2022).
- G. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2021a.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
 - 2. Manufacturer's installation instructions.
- B. Shop Drawings: Show panel joints, detail references, dimensions and methods of attachment.
- C. Samples: 12 inch x 12 inch sample of actual material and color charts showing manufacturer's full range of colors for Architect's selection.

1.5 QUALITY ASSURANCE

- A. Provide acoustical panels, diffusers and fabrics of each type required from one (1) manufacturer, of uniform texture and color.
- B. Installer. Provide evidence of appropriate experience in system installation and that installation method proposed is acceptable to panel manufacturer.
- C. Single Source Responsibility: Obtain acoustical panel materials from a single manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Carefully protect work during shipment, storage and installation.
- B. Deliver materials to job site and store elevated above floor in an enclosed space with proper ventilation and protection from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. Acoustical Panels:
 - a. Acoustical Resources, Inc.
 - b. Armstrong World Industries.
 - c. Autex Acoustics.
 - d. AVL Systems, Inc.
 - e. Benton Brothers Solutions, Inc.
 - f. Conwed Designscapes.
 - g. Decoustics.
 - h. Golterman & Sabo, Inc.
 - i. Kirei USA, LLC.
 - j. Lamvin, Inc.
 - k. MBI Products Company.
 - l. Rockfon.
 - m. Sky Acoustics.
 - n. Sound Concepts.
 - o. Wall Technology, Inc.
 - 2. Fabric Facings:
 - a. Guilford of Maine.
 - 3. Wood Fiber Acoustical Panels:
 - a. Tectum, a division of Armstrong World Industries, Inc.
 - 4. Pre-formed canopy components.
 - a. Armstrong World Industries.
 - 5. Speaker Cloth:
 - a. Acoustone Corporation.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 MATERIALS

- A. Fabric-Faced Acoustical Room Components:
 - 1. Acoustical Room Component Type 1 (ARC-1): All panels over 7 feet-0 inches above finished floor.
 - a. Basis of Design Product/Manufacturer: "Basic Series Acoustical Panel" manufactured by Acoustical Resources, Inc.
 - b. Type: Absorber Panels.
 - c. Core Composition: 6-7 PCF medium density single glass fiber core.
 - d. Flame Spread: Class A, 25 or less.
 - e. NRC: 1.05 in accordance with ASTM C423.
 - f. Panel Edge Profile: Square, chemically hardened.
 - g. Size: Two (2) inches thick by size shown on drawings.

2. Fabric Facing: 100 percent polyester fabric, Guilford of Maine Anchorage - 2335 Series in colors selected by Architect from manufacturer's full range of colors, or approved equal. Finish shall be applied directly to face and edges of the panel and returned onto the back of the panel to provide a full finished edge. All corners shall be fully tailored.
 3. Mounting Accessories:
 - a. Top Clips and Brackets:
 - 1) Factory mounted concealed mechanical "Z" clips screw fastened to the back of resin hardened spots on panel at maximum 24 inch on center spacing.
 - 2) Set clips inboard one (1) to two (2) inches from panel edges.
 - 3) "Z" clips shall engage on galvanized single or double wall brackets with closed ends to prevent lateral panel movement.
 - 4) Clips shall be fabric covered if exposed to view.
 - b. Bottom: 6 inch hook & loop brackets shall be shimmed on stacked spacer panels to provide even face alignment.
- B. Cementitious Wood Fiber Panels:
1. Acoustical Room Component Type 13 (ARC-13): Cementitious Wood Fiber Panels
 - a. Basis of Design: "Tectum Finale" manufactured by Armstrong World Industries, Inc.
 - b. Material: Aspen wood fibers bonded with inorganic hydraulic cement.
 - c. Thickness: 1 inch.
 - d. NRC: 0.80.
 - e. Size: 47-3/4 inches wide by 8 feet long.
 - f. Frame: None.
 - g. Color: As selected by Architect.
 - h. Mounting Style: As indicated on Drawings.
 - i. Location: As indicated on Drawings.
- C. Pre-formed canopy components:
1. Acoustical Room Component Type 17 (ARC-17): Curved Canopy.
 - a. Component (ARC-17A): Small Canopy Hill.
 - 1) Material: Mineral fiber pre-formed in canopy shape.
 - 2) Thickness: 1-1/4-inch.
 - 3) Size: 36" by 36".
 - 4) Panel Arc: 129-inch radius.
 - 5) Surface Finish and Edge Detail: DuraBrite scrim on all sides, finished square edges.
 - 6) Mounting: As indicated on Drawings.
 - 7) NRC: 0.82
 - 8) Fire Rating: Class A: ASTM E84; Flame Spread Index 25 or under and Smoke Developed Index 50 or less.
 - 9) Basis of Design Product/Manufacturer: Soundscapes Canopies by Armstrong World Industries.
 - b. Component (ARC-17B): Small Canopy Valley.
 - 1) Material: Mineral fiber pre-formed in canopy shape.
 - 2) Thickness: 1-1/4-inch.
 - 3) Size: 36" by 36".
 - 4) Panel Arc: 129-inch radius.
 - 5) Surface Finish and Edge Detail: DuraBrite scrim on all sides, finished square edges.
 - 6) Mounting: As indicated on Drawings.
 - 7) NRC: 0.82
 - 8) Fire Rating: Class A: ASTM E84; Flame Spread Index 25 or under and Smoke Developed Index 50 or less.

- 9) Basis of Design Product/Manufacturer: Soundscapes Canopies by Armstrong World Industries.
 - c. Acoustical Room Component (ARC-17C): Large Canopy Hill.
 - 1) Material: Mineral fiber pre-formed in canopy shape.
 - 2) Thickness: 1-1/4-inch.
 - 3) Size: 46-1/2" by 75".
 - 4) Panel Arc: 129-inch radius.
 - 5) Surface Finish and Edge Detail: DuraBrite scrim on all sides, finished square edges.
 - 6) Mounting: As indicated on Drawings.
 - 7) NRC: 0.82
 - 8) Fire Rating: Class A: ASTM E84; Flame Spread Index 25 or under and Smoke Developed Index 50 or less.
 - 9) Basis of Design Product/Manufacturer: Soundscapes Canopies by Armstrong World Industries.
 - d. Acoustical Room Component (ARC-17D): Large Canopy Valley.
 - 1) Material: Mineral fiber pre-formed in canopy shape.
 - 2) Thickness: 1-1/4-inch.
 - 3) Size: 46-1/2" by 75".
 - 4) Panel Arc: 129-inch radius.
 - 5) Surface Finish and Edge Detail: DuraBrite scrim on all sides, finished square edges.
 - 6) Mounting: As indicated on Drawings.
 - 7) NRC: 0.82
 - 8) Fire Rating: Class A: ASTM E84; Flame Spread Index 25 or under and Smoke Developed Index 50 or less.
 - 9) Basis of Design Product/Manufacturer: Soundscapes Canopies by Armstrong World Industries.
- D. Speaker Cloth:
1. Vinyl coated fiberglass threads, mildew resistant, Class A fire retardant, in color and texture as selected by Architect from manufacturer's full line of colors and textures.
 2. Basis of Design: Acoustone Speaker Grille Cloth.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify dimensions to insure proper fabrication of materials.

3.2 INSTALLATION

- A. Install wall panels, ceiling diffusers, and fabrics only after all wet work has been completed and temperature conditions approximate conditions when space will be occupied.
- B. Install wall panels, ceiling diffusers, and fabrics in accordance with manufacturer's instructions and approved shop drawings.
- C. Install Tectum Wall Panels on Natatorium walls with venting space between the wall and panels in accordance with manufacturer's instructions.
- D. Install wall panels, and ceiling diffusers in proper alignment. Shim wall track as necessary to provide a level frame work.
- E. Arrange wall panels symmetrically on each wall, unless otherwise indicated, Remove wall panels, ceiling diffusers, and fabrics are damaged and unacceptable to Architect and replace with new undamaged materials at no expense to Owner.

END OF SECTION

SECTION 09 90 00 - PAINTING AND COATING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Surface preparation and field painting of exposed items and surfaces.
 - 2. Field preparation and painting of factory primed metal products and fabrications.
 - 3. Accessories necessary for a complete installation.
- B. Related Sections:
 - 1. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2019.
- C. ASTM D2486 - Standard Test Methods for Scrub Resistance of Wall Paints; 2017.
- D. ASTM D2805 - Standard Test Method for Hiding Power of Paints by Reflectometry; 2011 (Reapproved 2018).
- E. ASTM D4828 - Standard Test Methods for Practical Washability of Organic Coatings; 1994.
- F. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- G. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- H. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

1.4 DEFINITIONS

- A. Standard coating terms defined in ASTM D16 apply.
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85 degree meter.
 - 2. Eggshell refers to low sheen finish with a gloss range between 20 and 35 when measured at a 60 degree meter.
 - 3. Semi-gloss refers to medium sheen finish with a gloss range between 35 and 70 when measured at a 60 degree meter.
 - 4. Gloss refers to high sheen finish with a gloss range more than 70 when measured at a 60 degree meter.

1.5 SUBMITTALS

- A. Product Data: Submit technical data and information for block fillers, primers, paints, and coatings, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
 - 1. Indicate manufacturer's instructions for special surface preparation procedures, substrate conditions requiring special attention.
 - 2. Material List: Provide inclusive list of required coating materials. Indicate each material and cross reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number, series, and general classification.
- B. Samples: Submit for each type of paint system and in each color and gloss of topcoat.

1. Provide stepped samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. Provide list of material and application for each coat of each sample. Label each sample as to location and application.
 3. Submit samples on following substrates for review of color and texture only:
 - a. Concrete: Provide two 4 inch square samples for each color and finish.
 - b. Concrete Masonry: Provide two 4 inch x 8 inch samples of masonry, with mortar joint in the center, for each finish and color.
 - c. Painted Wood: Provide two 12 inch square samples of each color and material on hardboard.
 - d. Ferrous and Nonferrous Metals: Provide two 4 inch square samples of flat metal and two 8 inch long samples of solid metal for each color and finish.
- C. Product List: Submit list of including each paint system, color, and location of application. Use same product and location designations indicated in Finish Schedule.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Comply with Federal and local toxicity and air quality regulations and with Federal requirements on content of for heavy metals including but not limited to: lead and mercury. Do not use solvents in paint products that contribute to air pollution.
 2. Performance and Durability:
 - a. ASTM D16 Standard Terminology for Paint, Related Coatings, Materials, and Applications.
 - b. ASTM D2486 Standard Test Method for Scrub Resistance of Interior Wall Paint.
 - c. ASTM D2805 Standard Test Method for Hiding Power of Paints by Reflectometry.
 - d. ASTM D4828 Standard Test Method for Practical Washability of Organic Coatings.
- B. Applicator Qualifications: A firm or individual having minimum 5 years documented experience in applying paints and coatings similar in material, design, and extent to those indicated.
- C. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, product name, product code, color designation, VOC content, batch date, environmental handling, surface preparation, application, and use instructions.
- C. Paint Materials: Store at a minimum of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.
- D. Handling: Maintain a clean, dry storage area to prevent contamination or damage to materials.

1.8 FIELD CONDITIONS

- A. Apply waterborne paints when temperatures of surfaces to be painted and surrounding air are between 50 degrees F and 90 degrees F (10 degrees and 32 degrees C).
- B. Do not thin or add water to waterbased paints, including waterbased alkyds.
- C. Weather Conditions:
1. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
 2. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 degrees F (3 degrees C) above dew point; or to damp or wet surfaces.

3. Minimum Application Temperatures for Water based Paints: Between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C).
- D. Apply solvent thinned paints when temperatures of surfaces to be painted and surrounding air are between 45 degrees F. and 95 degrees F (7 degrees F and 35 degrees C).
 1. Minimum Application Temperature for Varnish Finishes: 65 degrees F (18 degrees C) for interior or exterior, unless required otherwise by manufacturer's instructions.
 2. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.
- E. Provide lighting level of 80 foot candles (860 lux) measured midheight at substrate surface.
- F. Labels: Do not paint over Underwriters Laboratories, Factory Mutual, other code required labels, or equipment name, identification, performance rating, or nomenclature plates.

1.9 WARRANTY

- A. Written warranty signed by the manufacturer and the installer in which the manufacture and installer agree to repair or replace paint and primers that fail within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Flaking or delamination of paint with the substrate.
 - b. Rust, scale, similar imperfections due to improper surface preparation.
 - c. Thinning or watering of paint beyond that considered acceptable of paint manufacturer.
 - d. Failure to achieve dry film thickness (DFT) recommended by manufacturer for each coat in a paint system.
 - e. Deterioration or loss of color of paint beyond normal weathering.
 2. Warranty Period: One year from date of Substantial Completion.

1.10 EXTRA MATERIALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Paint: 2 percent, but not less than 1 gallon (3.8 L) of each material and color applied.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 1. Benjamin Moore & Co.: www.benjaminmoore.com.
 2. Dulux, an AkoNobel company: www.dulux.co.uk.
 3. Dunn-Edwards Corporation: www.dunnedwards.com.
 4. Kelly-Moore Paints: www.kellymoore.com.
 5. PPG Industries, Inc.: www.ppgpaints.com.
 6. Rosco Laboratories; us.rosco.com.
 7. The Sherwin-Williams Company: www.sherwin-williams.com.
 8. Vista Paint Corporation: www.vistapaint.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 MATERIALS

- A. Basis of Specifications: The Sherwin-Williams Company.
- B. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not

permitted.

- C. Proprietary Names: Paint Schedule is based on a single manufacturer for convenience. Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that named products are required to the exclusion of comparable products of specified manufacturers. Furnish product technical data, including percent solids by weight and volume; VOC content limits and emissions data; and certificates of performance for comparable paint products of specified manufacturer.
- D. Subject to compliance with requirements, provide first quality, 100% acrylic, commercial or industrial products of one of the specified manufacturers. Residential products are not permitted.
- E. Material Compatibility: Provide each paint system including block fillers, primers, and finish coats, that are compatible with one another and with substrates indicated under conditions of service and application, demonstrated by manufacturer based on testing and field experience.
- F. Material Quality: Provide manufacturer's best quality commercial paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint material containers not displaying manufacturer's product identification will not be acceptable. Residential quality paint products are not permitted.
- G. Chemical Components of Interior Paints and Coatings: Provide products complying with limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and SCAQMD 1113.
 - 1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - 2. Restricted Components: Paints and coatings shall not contain components restricted by the EPA and SCAQMD 1113.
- H. Materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- I. Patching Materials: Latex filler compatible with paint systems.
- J. Fastener Head Cover Materials: Latex filler.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke to engage the services of a qualified testing agency to sample paint materials.
 - 1. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to site, samples may be taken at the site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

2.4 PAINT COLOR SCHEDULE

- A. Colors (P-#):
 - 1. P-1 - Ceiling:
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: Pearly White SW7009.
 - c. Sheen: EgShell.
 - d. Locations: All gypsum board ceilings and soffits unless noted otherwise.
 - 2. P-2 - Field:

- a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: Pearly White SW7009.
 - c. Sheen: EgShell.
 - d. Locations: All gypsum board ceilings and soffits unless noted otherwise.
3. P-3 - Black Accent:
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: Tricorn Black SW6258.
 - c. Sheen: EgShell.
 - d. Locations: As indicated on Drawings.
 4. P-4 - Blue Accent:
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: Bracing Blue SW6242.
 - c. Sheen: EgShell.
 - d. Locations: As indicated on Drawings.
 5. P-5 - Door Frames:
 - a. Manufacturer: The Sherwin-Williams Company.
 - b. Color: Gauntlet Gray SW7019.
 - c. Sheen: Semi-Gloss.
 - d. Locations: As indicated on Drawings.
 6. P-6 - Black Box Floor:
 - a. Manufacturer: Rosco.
 - b. Color: Black.
 - c. Sheen: Eggshell.
 - d. Locations: As indicated on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for maximum moisture content and conditions affecting performance of the work.
- B. Test substrates after repairing and cleaning substrates but prior to application of paint and coatings.
 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Fiber Cement Board: 12 percent.
 - c. Masonry (Clay and CMUs): 12 percent.
 - d. Wood: 15 percent.
 - e. Gypsum Board: 12 percent.
 - f. Plaster: 12 percent.
 2. Test cementitious and plaster cement/stucco for alkalinity (pH).
- C. Gypsum Board Substrates: Verify taped joints are tapes and finishing compound is sanded smooth.
- D. Plaster Substrates: Verify plaster has fully cured. Verify existing plaster is in good condition and can receive new paint coating.
- E. Spray Textured Ceiling Substrates: Verify surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
 1. Verify previously painted surfaces can be stripped to bare substrate, repaired if necessary, and prepared to receive new paint system consisting of primer and two top coats at a minimum.

- a. Note: Previously painted surfaces have failed to accept new paint systems. Determined cause of failure and take corrective measures to ensure each surface accepts new paint system. Failure of new paint system is not permitted.
- G. Commence paint and coating application after correcting unsatisfactory conditions and surfaces are dry. Application of coating indicates applicator's acceptance of surfaces and conditions.

3.2 ITEMS TO RECEIVE PAINT

- A. Generally, all new items that are normally painted in any typical building, including but not limited to the following list:
 - 1. All ferrous metal.
 - 2. All exterior galvanized metal.
 - 3. All exterior wood.
 - 4. All interior wood.
 - 5. All prime coated hardware.
 - 6. All exposed pipe, plumbing, ductwork, conduit, outlet boxes and electrical cabinets, excluding those located in mechanical rooms.
 - 7. All metal grilles, except aluminum, unless otherwise indicated.
 - 8. All exposed gypsum board surfaces, including all mechanical rooms.
 - 9. Miscellaneous other items which normally require painting or are scheduled to be painted.
 - 10. Consult plans, finish schedule, details and specifications for other trades as all items usually field painted or finish will be considered as part of the Contract.
 - 11. All exposed mechanical equipment and electrical equipment.
 - 12. Traffic lanes and parking spaces including fire lanes and crosswalks.
 - 13. Rolling doors.
 - 14. Bollards.
 - 15. Loose lintels.
 - 16. Refer to MEP specifications for additional items to receive paint.
- B. All work where a coat of material has been applied must be inspected and approved by Architect before application of succeeding specified coat, otherwise no credit for coat applied will be given. Notify Architect when a particular coat has been completed for inspection and approval. Apply coats of material in strict accordance with manufacturer's specifications except where requirements of these specifications are in excess of manufacturer's requirements. Paint all sight exposed pipe and plumbing only after all mechanical work and tests have been completed.

3.3 PREPARATION

- A. Coordination of Work: Review work in which primers are provided to ensure compatibility of the total system for various substrates. Notify Architect of anticipated problems when using materials specified over substrates primed by others.
 - 1. Pre-Primed Substrates: Inspect existing conditions in which primers are factory applied to ensure compatibility of the total system for each substrate. Notify Architect of anticipated problems when using the materials specified over factory primed or pre-primed substrates.
 - 2. Existing Painted Surfaces: Inspect previously painted surfaces to ensure compatibility of the existing paints with new paint system for each substrate. Notify Architect of anticipated problems.
 - 3. Correct defects and clean surfaces affecting bond with paint system. Remove existing paints exhibiting loose surface defects showing signs of rust, scale, or delamination.
 - 4. Seal marks which may bleed through surface finishes.
- B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified. Provide barrier coats over incompatible primers or remove and reprime. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting.

1. Remove hardware and hardware accessories, plates, lighting fixtures, and similar items that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface applied protection before surface preparation and painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
 2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface applied protection if any.
 3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 4. Clean and prepare surfaces to receive paint according to manufacturer's written instructions for each substrate condition and as specified. Provide barrier coats over incompatible primers, existing paint or coating, or remove and reprime.
 5. Correct defects and clean surfaces affecting bond with paint or coating system. Remove existing coatings exhibiting loose surface defects. Seal marks which may bleed through surface finishes.
- C. Cleaning: Before applying paint or surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning. Schedule cleaning and painting so dust and contaminants from the cleaning process will not fall on wet, newly painted surfaces.
1. Remove incompatible primers, including factory applied primers, and reprime substrate with compatible primers or apply barrier coat as necessary to produce paint systems indicated.
 2. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 3. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
 4. Galvanized Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
 5. Aluminum Substrates: Remove surface oxidation.
- D. Mildew and Mold Removal: Remove mildew and mold by high power washing (pressure range of 1500 to 4000 psi) with solution of trisodium phosphate and bleach. If substrate is too soft for high power washing, scrub substrate with solution. Rinse with clean water and allow surface to dry.
- E. Protective Coverings: Provide protections for duration of the work, including covering furnishings and decorative items. Protect and mask adjacent finishes and components against damage, marking, overpainting, and injury. Clean and repair or replace damage caused by painting.
- F. Renovated Surfaces: Clean surface free of loose dirt and dust. Except at gypsum board surfaces, remove existing paint and coatings to bare substrate and prepare substrates to receive new paint system. Test substrate to verify it will bond with primer and receive new paint system without failure. If test fails, clean surface to base substrate and apply barrier coat. Retest to verify surface will accept new paint system.
1. Remove surface film preventing proper adhesion and bond.
 2. Wash glossy paint with a solution of sal soda and rinse thoroughly.
 3. Remove loose, blistered, and defective paint and varnish; smooth edges with sandpaper.
 4. Clean corroded iron and steel surfaces.
 5. Repair and blend into portland cement plaster.
 6. Prime bare surfaces.
 7. Tone varnished surfaces with stain bringing to uniform color.

8. If existing surfaces cannot be put in acceptable condition for finishing by customary cleaning, sanding, and puttying operations, notify Owner and do not proceed until correcting unsatisfactory conditions.
- G. Cementitious Substrates: Prepare concrete surfaces to receive paint. Remove efflorescence, chalk, dust, dirt, grease, oils, release agents, mold, mildew, and existing paint. Roughen as necessary to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 1. Use abrasive blast cleaning methods if recommended by paint manufacturer.
 2. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions.
 - a. Determine alkalinity and moisture content of surfaces by performing appropriate pH testing. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct condition prior to application of paint.
 - b. Anhydrous Calcium Chloride Test: ASTM F1869 . Proceed with installation after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.3 kg of water/92.9 sq. m).
 - c. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation after substrates have obtained percent relative humidity level recommended by paint manufacturer.
 - d. Perform additional moisture tests when recommended by manufacturer. Proceed with installation when moisture content complies with that permitted in manufacturer's written instructions.
 - e. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to thoroughly dry.
 3. Clean concrete floors to receive paint or coating with a 5 percent solution of muriatic acid or etching cleaner. Flush floors with clean water to remove acid; neutralize with ammonia, rinse, allow to dry; vacuum before painting.
- H. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.
 1. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
 2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
- I. Galvanized Ferrous Metal Substrates: Clean galvanized surfaces with nonpetroleum based solvents leaving surface free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- J. Shop Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop primed surfaces.
- K. Aluminum Substrates: Clean surfaces to remove oil, grease, surface oxidation, and contaminants in accordance with SSPC SP-1 Solvent Cleaning. Lightly abrade surface with a nonmetallic pad.
- L. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

- M. Plaster/Stucco Substrates: Remove contaminants, release agents, curing compounds, efflorescence, chalk, mold, mildew, and similar deterrents. Spot patch existing plaster to eliminate blisters, buckles, excessive crazing, and to check cracking, dryouts, efflorescence, sweat outs, and similar defects the prevent plaster from bonding with paint or coatings. Sand or texture repair or patch to match adjacent finish and to remove trowel marks and arrises.
1. Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
 2. Deep Cracks: Clean out and fill deep cracks with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
 3. Do not paint surfaces if moisture content or alkalinity of surfaces exceeds that permitted in manufacturer's written instructions. Test for alkali using litmus paper.
 4. Allow patching and repair compounds to set and cure before painting.
- N. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- O. Wood Substrates:
1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 2. Sand surfaces that will be exposed to view, and dust off.
 3. Prime, stain, or seal wood to be painted. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 4. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
 5. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- P. Pipe Covering and Insulation: Clean to remove loose, foreign, and objectionable material before applying sealing coat.
- Q. Preparation of Substrates for Wallcovering: Prime and seal substrate with release coat in accordance with wallcovering manufacturer's recommendations for substrate.
1. Assure compatibility with product of wall covering manufacturer.
 2. Fill indentations in substrate and prime with opaque white primer before applying release coat.
 3. Apply release coat in accordance with manufacturer's recommendations.
- R. Barrier Coat: Provide barrier coats over incompatible primers or remove and reprime. Notify Owner in writing of anticipated problems using specified finish coat material over previously coated substrates.
- S. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Do not use thinners for water based paints.
 4. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.4 APPLICATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
1. The term exposed surfaces includes areas visible when permanent or built in fixtures, grilles, convactor covers, covers for finned tube radiation, and similar components are in place. Extend coatings in these areas to maintain system integrity and provide desired protection.
 2. Use applicators and techniques suited for paint and substrate indicated.
 3. Provide finish coats compatible with primers.
 4. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 5. Paint exposed surfaces. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces.
 - a. Field painting of exposed surfaces include bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory applied final finish.
 - b. Areas visible when permanent or built in fixtures, grilles, convactor covers, covers for finned tube radiation, and similar components are in place.
 - c. Extend coatings in areas, as required, to maintain system integrity and provide desired protection.
 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 7. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 8. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 9. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 10. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or surface imperfections. Cut in sharp lines and color breaks.
 11. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 12. Provide finish coats compatible with primers used.
 13. Sand lightly between each succeeding enamel or varnish coat.
- B. Items not to Receive Paint: Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
- C. Applicators: Apply paints and coatings by brush, roller, spray, or applicators recommended by manufacturer.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool recommended by manufacturer for material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

1. Measure film thickness on magnetic surfaces by use of Elcometer thickness gauge and on nonmagnetic surfaces by pit gauge or Tooke Gauge.
- E. Application: Apply first coat to surfaces that have been cleaned, pretreated, or prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
 2. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished after removing rust and scale and priming or touching up surface sand if acceptable to topcoat manufacturers.
 3. If undercoats, stains, or conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried and cured to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- F. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
 3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
 4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
 6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
 7. Concealed Members: Wherever steel and metal parts to receive paint are built into and concealed by construction, paint as specified for exposed parts so finish painting is complete before members are concealed.
- G. Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work: Painting is limited to items exposed in equipment rooms and occupied spaces.
1. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 2. Prime and paint uninsulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, heat exchangers, tanks, ductwork, conduit, switchgear, and paintable insulation except where items are prefinished.
 3. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint, to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
 4. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

5. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated. Color band and identify with flow arrows, names, and numbering.
6. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.
- H. Electrostatic Spray Painting: Apply coating electrostatically to finished surfaces, free from runs, sags, visible overlaps, holidays, craters, pinholes and other defects detrimental to protective and decorative qualities of coating.
 1. Thickness of Coatings: 1.5 to 2.0 mils dry film thickness. Measure dry film thickness with magnetic gauge.
 2. Use application techniques, equipment, materials, and preparation procedures recommended by manufacturer.
- I. Block Fillers: Apply block fillers to concrete masonry block at rate to ensure complete coverage with pores filled.
- J. Prime Coats: Before applying finish coats, apply prime coat, recommended by manufacturer, to material required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or defects due to insufficient sealing.
- K. Finish Coats: Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance without bleed through.
 1. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or surface imperfections is not acceptable.
 2. Transparent (Clear) Finishes: Use multiple coats to produce glass smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- M. Touch Up: Touch up marred, scraped, and blemished areas of surfaces which were factory primed or previously coated.
 1. Prepare and touch up scratches, abrasions, and blemishes and remove foreign matter before proceeding with succeeding coats.
 2. Touch up marred, scraped, and blemished areas of factory primed or previously coated surfaces.
 3. Feather touch up coating overlapping minimum 2 inches onto adjacent unblemished areas producing smooth, uniform surface.
 4. As soon after erection and installation as possible, touch up fasteners, welded surfaces and surroundings, field connections, and areas on which shop coat has been abraded or damaged with specified primer before corrosion and other damage occurs from exposure.

3.5 FIELD QUALITY CONTROL

- A. Dry Film Thickness (DFT) Testing: Tests for dry film thickness may be determined by using a Tooke Scale and microgroover, an electronic scanner, or the Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.6 CLEANING AND PROTECTION

- A. It is of the utmost important to the Owner that the sites remain in a safe, clean, and well maintained condition. At the end of each day, leave the site ready to use by staff and students. Protect staff and students and the learning environment throughout the work.
- B. Cleanup: At the end of each day, remove empty cans, rags, rubbish, and discarded paint materials from site. After completion of painting work, clean glass and paint spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work. After related work is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.
- E. At completion of painting activities, touch up and restore damaged or defaced painted surfaces.
- F. Waste Management: Legally dispose of unused paint and paint containers in accordance with manufacturer's recommendations and environmental regulations.

PART 4 SCHEDULES

4.1 GENERAL

- A. The following is a schedule of typical painted items and does not specifically include every item that is to receive paint but should establish type and quality of finish for all items normally included in a complete paint job.
- B. Overhead Painting (Ceilings, Exposed to Structure Above, etc.)
 - 1. Use a dryfall system comparable to system defined below for substrate.

4.2 DUNN EDWARDS APPLICATION SCHEDULES

- A. Exterior Surfaces (Note: Exterior surfaces are divided into two (2) different categories, based upon color and level of graffiti resistance required. System 1 shall be used when standard earthtone colors or neutral colors are specified, and System 2 shall be used when bright colors [primary reds, yellows, and oranges] are specified and/or when a graffiti resistant coating is required):
 - 1. Galvanized Metal:
 - a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations. Krud Kutter Metal Clean and Etch.
 - b. Primer: One (1) coat Ultrashield ULDM00 DTM Gray Primer.
 - c. Finish: Two (2) coats Ultrashield ULSH40 Low Sheen High Performance Acrylic Urethane.
 - d. Finish: Two (2) coats US Coatings RustGrip 2300 1-2 Mils DFT.
 - 2. Un-galvanized Metal:
 - a. Primer: One (1) coat Ultrashield ULDM00 DTM Gray Primer.
 - b. Finish: Two (2) coats Ultrashield ULSH40 Low Sheen High Performance Acrylic Urethane.
 - 3. Concrete and CMU:
 - a. Primer/Finish: (2) coats Eff-Stop Premium ESPR00 Masonry Primer / (2) coats US Coatings AquaGrip 2600 3-5 Mils DFT.
 - 4. Wood (Includes plywood siding and wooden trim):
 - a. Primer: One (1) coat EZ-Prime EZPR00 Exterior Wood Primer.
 - b. Finish: Two (2) coats Spartashield SSSL60 100% Acrylic Gloss.

5. Fiber-Cement Materials:
 - a. Primer: One (1) coat Eff-Stop Premium ESPR00 Masonry Primer.
 - b. Finish: Spartashield SSSL60 100% Acrylic Gloss.
 6. Parking Line and Driveway Paint: Vin-L-Stripe VSZM10 Zone Marking Paint Yellow.
 7. All piping in mechanical rooms shall be painted in their entirety, in the following colors: Aristoshield ASHL70 High-Gloss Enamel:
 - a. Gas lines: Orange
 8. Domestic cold water: White
 - a. Domestic hot water: Pink
 - b. Heating hot water: Red
 9. Condenser water: Green
 - a. Chilled water: Blue
- B. Interior Surfaces:
1. Galvanized Metal:
 - a. Primer: One (1) coat Ultrashield Galvanized Metal Primer ULGM00.
 - b. Finish: Two (2) coats Aristoshield ASHL50 Semi-Gloss Enamel.
 2. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):
 3. Shop coat by others.
 - a. One (1) coat over Steel: Bloc-Rust Premium BRPR00 Rust Preventative Primer; Aluminum: Ultrashield Galvanized Metal Primer ULGM00.
 - b. Two (2) coats Aristoshield ASHL50 Semi-Gloss Enamel.
 4. Gypsum Wallboard:
 - a. Primer: One (1) coat Vinylastic Premium VNPR00 Acrylic Wall Sealer.
 - b. Finish: Two (2) coats Spartawall Premium SWLL30 Acrylic Latex Eggshell.
 5. Primer Concrete and CMU (Enamel):
 - a. One (1) coat Smooth Blocfil Premium SBPR00 100% Acrylic Block Filler.
 - b. Finish: Two (2) coats Premium SWLL50 Acrylic Latex Semi-Gloss.
 6. Wood (Painted):
 - a. Primer: Interkote Premium IKPR00 100% Acrylic Enamel Undercoater.
 - b. Finish: Aristoshield ASHL50 Semi-Gloss Enamel.
 7. Wood (Stained):
 - a. Stain: Gemini Craftsman Collection Wiping Stain CCW Water-Based Series.
 - b. Finish (First Coat): WB-0230 Gemini Titanium Clear Urethane Satin
 - c. Finish (Second Coat): Gemini WB-0230 Gemini Titanium Clear Urethane Satin.
 8. Gypsum Wallboard (Epoxy) – Kitchens, bathrooms, laboratories, etc.:
 - a. Primer: One (1) coat US Coatings AquaGrip 2600 2-3 Mils DFT.
 - b. Finish: Two (2) coats US Coatings AquaGrip 2600 3-5 Mils DFT per coat.
 9. CMU (Epoxy) - Kitchens, bathrooms, laboratories, etc.:
 - a. Primer: Two (2) coats Smooth Blocfil Premium SBPR00 100% Acrylic Block Filler.
 - b. Finish: Two (2) coats US Coatings AquaGrip 2600 3-5 Mils DFT.
 10. Pipe and fittings, including but not limited to copper and brass, at kitchen areas (but excluding aluminum, stainless steel, nickel and chrome plated pipe and fittings):
 - a. Primer: One (1) coat; US Coatings RustGrip 2300 1-2 Mils DFT.
 - b. Finish: Two (2) coats bright aluminum paint, US Coatings UreGrip 3000 VOC 2-3 Mils DFT per coat.
- C. Paint Types: Refer to the Finish Schedule in the Drawings.

4.3 PPG APPLICATION SCHEDULES

- A. Exterior:
1. Galvanized Metal:

- a. Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
 - b. Better: One (1) coat Speedhide Int/Ext Galvanized Steel Primer, 6-209 Series.
 2. Field Weld Touch-Up on Galvanized Metal:
 - a. Two (2) coats Speedhide Int/Ext Galvanized Steel Primer, 6-209 Series.
 3. Shop-Primed Ferrous Metals:
 - a. Clean all bare and abraded areas to bright, bare metal and touch up with either:
 - b. One (1) coat Speedhide Int/Ext Rust Inhibitive Steel Primer, 6-208 Series.
 4. Wood (Painted Finish):
 - a. One (1) coat Seal Grip Int/Ext Acrylic universal Primer/Sealer 17-921
 - b. Two (2) coats Sun Proof Exterior House & Trim Flat 100% Acrylic 72-45.
 5. Concrete Block (Flat, smooth finish CMU):
 - a. One (1) coat Speedhide Int/Ext Masonry Hi Fill Block Filler Latex, 6-15 Series
 - b. Two (2) coats Sun Proof Exterior House & Trim Flat 100% Acrylic 72-45.
- B. Interior:
1. Gypsum Board Walls:
 - a. Ceilings and locations not scheduled to receive enamel finish.
 - 1) One (1) coat Speedhide Interior Latex Sealer Quick Drying, with texture added, 6-2 Series.
 - 2) Two (2) coats Speedhide Interior Paint Flat Latex, 6-70 Series.
 - b. Walls scheduled to receive enamel paint.
 - 1) One (1) coat Speedhide Interior Latex Sealer Quick Drying, with texture added, 6-2 Series.
 - 2) Two (2) coats Speedhide Interior Enamel Eggshell Latex, 6-411 Series.
 2. Wood (Painted):
 - a. One (1) coat Seal Grip Interior/Ext Acrylic Universal Primer/Sealer 17-921
 - b. Two (2) coats Speedhide Interior Enamel Wall and Trim Semi-gloss, 6-1110 Series.
 3. Wood (Stained):
 - a. Two (2) coats Deft Interior Water-Based Gloss Polyurethane DFT158.
 4. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):
 - a. Shop coat by others.
 - b. Touch up bare areas with Pitt Tech Plus Int/Ext DTM Primer, 90-912 Series.
 - c. One (1) coat Pitt Tech Plus Int/Ext DTM Primer 90-912.
 - d. Two (2) coats Pitt Tech Plus Int/Ext DTM Semi-Gloss Industrial 90-1210.
 5. Galvanized Metals (Use for all exposed interior galvanized metal):
 - a. Clean and acid etch as necessary.
 - b. One (1) coat Pitt Tech Plus Int/Ext Industrial Primer, 90-912 Series.
 - c. Two (2) coats Pitt Tech Plus Int/Ext Industrial Semi-Gloss 90-1210.
 6. Concrete Block (CMU):
 - a. General: Stop block filler and paint 1/2 inch below top of floor base material at all wall surfaces.
 - b. Latex Enamel (Corridors, Classrooms, Offices, and where shown on drawings):
 - 1) One (1) coat One (1) coat Speedhide Int/Ext Masonry Hi Fill Block Filler Latex, 6-15 Series.
 - 2) Two (2) coats Speedhide zero interior Zero-Voc Semi-Gloss 6-4510.
 7. Epoxy (Kitchen, and where shown on drawings):
 - a. One (1) coat Pitt-Glaze Int/Ext Block Filler Latex, 16-90 series.
 - b. Two (2) coats Pitt-Glaze WB1 Acrylic Epoxy Semi-Gloss 16-310 Series.

4.4 SHERWIN-WILLIAMS APPLICATION SCHEDULES

- A. Exterior Surfaces: Note: Exterior surfaces are divided into two (2) different categories, based upon color and level of graffiti resistance required. System 1 will be used when standard earthtone colors or neutral colors are specified, and System 2 will be used when bright colors (primary reds, yellows, and oranges) are specified and/or when a graffiti resistant coating is required.
1. Galvanized Metal:
 - a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
 - b. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
 - c. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300).
 2. Galvanized Metal: Chloramine environment.
 - a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six (6) months prior to beginning painting operations.
 - b. Primer: One (1) coats Macropoxy 646 (B58-600).
 - c. Finish: Two (2) coats Acrolon 218 HS Acrylic Polyurethane (B65-600).
 3. Un-galvanized Metal:
 - a. Primer: One (1) coat Pro-Cryl Pro Industrial Universal Primer (B66W310).
 - b. Finish: Two (2) coats Sher-Cryl HPA High Performance Acrylic (B66W300).
 4. Pre-Finished Metal Surfaces:
 - a. Surface Preparation: As recommended by primer manufacturer.
 - b. Primer: One (1) coat Bond-Plex Waterbased Acrylic.
 - 1) OR
 - 2) Primer: One (1) coat DTM Bonding Primer.
 - c. Finish: Two (2) coats Bond-Plex Waterbased Acrylic.
 5. Concrete and CMU:
 - a. Primer/Finish: (2) coats Loxon XP Exterior Waterproofing System, 14-18 mils wet, 6.4 – 8.3 mils dry per coat.
 6. Tilt-Up Concrete:
 - a. Primer: One (1) coat Loxon Concrete and Masonry Primer Sealer (LX02W50), 5.3-8.0 mils wet, 2.1-3.2 mils dry.
 - b. Finish: One (1) coat Conflex UltraCrete Acrylic Textured Finish, Texture: Fine, Base Color: CF17W0811 Medium Extra White.
 7. Wood (Includes plywood siding and wooden trim):
 - a. Primer: One (1) coat A-100 Latex Wood Primer (B42W41).
 - b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 ser.).
 8. Fiber-Cement Materials:
 - a. Primer: One (1) coat Loxon Masonry Primer (A24W300).
 - b. Finish: Two (2) coats A-100 Acrylic Gloss (A8 Series).
 9. Parking Line and Driveway Paint: Setfast Waterborne Yellow (TM225) (meets Federal Specification (FS) TTP-1952-B)
- B. Interior Surfaces:
1. Concrete Substrates, Non-Traffic Surfaces and Clay Masonry:
 - a. Latex System:
 - 1) Prime Coat: Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
 - 2) Intermediate Coat: Latex, interior, matching topcoat.
 - 3) Topcoat:
 - (a) Flat: ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.

- (b) Low Sheen: ProMar 200 Zero VOC Latex Low Sheen Eg-Shel, B24-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - (c) Eggshell: ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
 - (d) Semi-Gloss: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - (e) Gloss: ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
 - b. Water-Based Light Industrial Coating System:
 - 1) Prime Coat: Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils (0.203 mm) wet, 3.2 mils (0.081 mm) dry.
 - 2) Intermediate Coat: Latex, interior, matching topcoat.
 - 3) Topcoat:
 - (a) Eggshell: Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - (b) Semi-Gloss: Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
- 2. Concrete Substrates, Pedestrian Traffic Surfaces:
 - a. Latex Floor Enamel System:
 - 1) First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - 2) Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils (0.038 to 0.051 mm) dry per coat.
- 3. Flat: Galvanized Metal:
 - a. Latex System:
 - 1) Prime Coat: One (1) coat Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
 - 2) Intermediate Coat: Water-based acrylic, interior, matching topcoat.
 - 3) Topcoat:
 - (a) Semi-Gloss: Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
 - (b) Gloss: Pro Industrial Acrylic Gloss Coating, B66-660 Series, at 2.5 to 4.0 mils (0.064 to 0.102 mm) dry, per coat.
 - b. Water-Based Dry-Fall System:
 - 1) Top Coat:
 - (a) Flat: S-W Pro Industrial Waterborne Acrylic Dryfall Flat, B42-181 Series, at 6.0 mils (0.152 mm) wet, 1.5 mils (0.038 mm) dry.
 - (b) Eggshell: Pro Industrial Waterborne Acrylic DryFall Eg-Shel, B42-82, at 6.0 mils (0.152 mm) wet, 1.9 mils (0.048 mm) dry.
 - (c) Semi-Gloss: Pro Industrial Waterborne Acrylic DryFall Semi-Gloss, B42-83, at 5.8 mils (0.147 mm) wet, 2.3 mils (0.058 mm) dry.
 - c. Water-Based Light Industrial Coating System:
 - 1) Prime Coat: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils (0.127 to 0.254 mm) wet, 2.0 to 4.0 mils (0.051 to 0.102 mm) dry.
 - 2) Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - 3) Top Coat:
 - (a) Eggshell: Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - (b) Semi-Gloss: Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
- 4. Shop-Primed Ferrous Metals (Use for metal doors and frames and miscellaneous metal items):

- a. Shop coat by others.
 - b. One (1) coat over Steel Kem Kromik Primer B50series.
 - c. One (1) coat over Aluminum Metal Procryl Primer B60series.
 - d. Two (2) coats PM200 Alkyd Semi-Gloss B34series.
5. Wood: (Painted)
- a. Latex System:
 - 1) Prime Coat: PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
 - 2) Intermediate Coat: Latex, interior, matching topcoat.
 - 3) Topcoat:
 - (a) Eggshell: ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.
 - (b) Semi-Gloss: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - (c) Gloss: ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - b. Water/Alkyd Urethane System:
 - 1) Prime Coat: Premium Wall & Wood Primer, B28W8111, at 4.0 mils (0.102 mm) wet, 1.8 mils (0.046 mm) dry.
 - 2) Intermediate Coat: Water-based alkyd-urethane, interior, matching topcoat.
 - 3) Topcoat:
 - (a) Semi-Gloss: Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
 - (b) Gloss: Pro Industrial Waterbased Alkyd Urethane Gloss, B53-1050 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry, per coat.
 - c. Water-Based Light Industrial Coating:
 - 1) Prime Coat: PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils (0.102 mm) wet, 1.4 mils (0.036 mm) dry.
 - 2) Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - 3) Topcoat:
 - (a) Eggshell: Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - (b) Semi-Gloss: Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
6. Wood: (Stained)
- a. Stain: SherWood BAC Wiping Stain (S64 Series).
 - b. Finish (First Coat): Wood Classics Polyurethane Varnish (A67 Series).
 - c. Finish (Second Coat): Wood Classics Polyurethane Varnish (A67 Series).
7. Gypsum Board and Plaster:
- a. Latex System:
 - 1) Prime Coat: ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.
 - 2) Intermediate Coat: Latex, interior, matching topcoat.
 - 3) Topcoat:
 - (a) Flat: ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - (b) Low Sheen: ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - (c) Eggshell: ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils (0.102 mm) wet, 1.7 mils (0.043 mm) dry, per coat.

- (d) Semi-Gloss: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils (0.102 mm) wet, 1.6 mils (0.041 mm) dry, per coat.
 - (e) Gloss: ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - b. Water-Based Light Industrial Coating System:
 - 1) Prime Coat: ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils (0.102 mm) wet, 1.0 mils (0.025 mm) dry.
 - 2) Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - 3) Topcoat:
 - (a) Eggshell: Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
 - (b) Semi-Gloss: Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46-151 Series, at 4.0 mils (0.102 mm) wet, 1.5 mils (0.038 mm) dry, per coat.
- 8. CMU: (Epoxy) - Kitchens, bathrooms, laboratories, etc.
 - a. Primer: Two (2) coats Heavy Duty Block Filler (B42W46).
 - b. Finish: Two (2) coats Water-Based Catalyzed Epoxy (B70/B60).
- 9. Pipe and fittings, including but not limited to copper and brass, at kitchen areas (but excluding aluminum, stainless steel, nickel and chrome plated pipe and fittings):
 - a. Primer: One (1) coat; product recommended for the substrate by the finish coat manufacturer.
 - b. Finish: Two (2) coats bright aluminum paint.

END OF SECTION

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SECTION 10 11 00 - VISUAL DISPLAY UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Porcelain enamel steel markerboards.
 - 2. Glass markerboards.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Blocking and supports.
 - 2. Section 06 20 00 - Finish Carpentry: Wood frame and marker rails.
 - 3. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.
 - 4. Section 09 90 00 - Painting and Coating: Finishing of wood frame and marker rail.
 - 5. Section 10 22 39 - Folding Panel Partitions: Installation of visual display boards on operable partitions.

1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).
- C. ANSI A208.1 - American National Standard for Particleboard; 2022.
- D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- E. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.
- F. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2012, with Editorial Revision (2019).
- G. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- H. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- I. {RSTEMP#623}ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass;2014.
- J. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- L. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2020.
- M. PS 1 - Structural Plywood; 2023.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide manufacturer's data on chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
- D. Samples: Color charts for selection of color and texture of chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard, tackboard surface covering, and trim.
- E. Samples: Two, 2 by 2 inches (50 by 50 mm) in size illustrating materials and finish, color and texture of chalkboard, porcelain enamel steel markerboard, glass markerboard, tackboard,

tackboard surfacing, and trim.

- F. Test Reports: Show compliance to specified surface burning characteristics requirements.
- G. Manufacturer's printed installation instructions.
- H. Manufacturer's Qualification Statement.
- I. Maintenance Data: Include data on regular cleaning, stain removal, and _____.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Provide five year warranty for chalkboard and markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 VISUAL DISPLAY UNITS

- A. Porcelain Enamel Steel Markerboards:
 - 1. Color: White.
 - 2. Steel Face Sheet Thickness: 24 gauge, 0.0239 inch (0.61 mm).
 - 3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
 - 4. Backing: Aluminum foil, laminated to core.
 - 5. Size: As indicated on drawings.
 - 6. Frame: Same as for chalkboards.
 - 7. Frame: Extruded aluminum , with concealed fasteners.
 - 8. Frame Profile: As indicated on drawings.
 - 9. Frame Finish: Anodized, natural.
 - 10. Accessories: Provide marker tray and map rail.
 - 11. Acceptable Products:
 - a. LCS3 by Claridge Products and Equipment, Inc.
- B. Large-Format, Magnetic, Glass Markerboards: Back-coated glass, laminated to steel.
 - 1. Basis of Design:
 - a. Wall2Wall manufactured by Clarus Glass Boards.
 - 2. Glass: 1/4 inch thick, low-iron, tempered safety writing glass with eased corners, laminated to steel backing sheet for use with magnets.
 - a. Color: White.
 - b. Finish: Polished.
 - 3. Size: As indicated on Drawings.
 - 4. Steel Backing Sheet Thickness: 24 gauge, 0.0239 inch (0.61 mm).
 - 5. Frame: As selected by the Architect.
 - a. Frame Profile: As selected by the Architect.
 - b. Frame Finish: Anodized, natural.
 - 6. Mounting: Concealed Z clips.

7. Accessories: Provide magnetic marker tray, magnetic marker holder, magnetic eraser, and magnets.

2.3 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Hardboard for Chalk Surface: ANSI A135.4 Tempered type.
- C. Float Glass: Provide float-glass-based glazing unless otherwise indicated.
 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 2. Kind HS - Heat-Strengthened Type: Comply with ASTM C1048.
 3. Kind FT - Fully Tempered Type: Comply with ASTM C1048.
 4. Fully Tempered Safety Glass: Comply with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
 5. Thickness: As indicated.
- D. Laminated Glass: Float glass laminated in accordance with {RS#623}.
 1. Laminated Safety Glass: Comply with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.
 2. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch (0.762 mm) thick, minimum.
 3. Ionoplast Interlayer: 0.035 inch (0.889 mm) thick, minimum.
- E. Burlap: Tightly woven, flame retardant treated.
- F. Plywood: PS 1 Grade C-D , softwood.
- G. Hardboard for Cores: ANSI A135.4, Class 1 - Tempered, S2S (smooth two sides).
- H. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- I. Gypsum Board: ASTM C1396/C1396M, paper/foil faced, plain type.
- J. Fiber Board: ASTM C208, cellulosic fiber board.
- K. Foil Backing: Aluminum foil sheet, 0.005 inch thick (0.13 mm thick).
- L. Aluminum Sheet Backing: 27 gauge, 0.014 inch (0.36 mm) thick.
- M. Steel Sheet Backing: 28 gauge, 0.0149 inch (0.38 mm), galvanized.
- N. Adhesives: Type used by manufacturer.

2.4 ACCESSORIES

- A. Wood Frames: Factory assembled red oak, with factory applied clear varnish finish.
- B. Wood Frames: Refer to Section 06 20 00 - Finish Carpentry.
- C. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall (; 25 mm wide overall) , full width of frame.
- D. Map Supports: Formed aluminum sliding hooks and roller brackets to fit map rail.
- E. Temporary Protective Cover: Sheet polyethylene, 8 mil (0.2 mm) thick.
- F. Flag Holders: Cast aluminum bored to receive 1 inch (25 mm) diameter flag staff, bracketed to fit top rail of board.
- G. Cleaning Instruction Plate: Provide instructions for chalkboard cleaning on a metal plate fastened to perimeter frame near chalkrail.
- H. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.
- I. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.
- C. Verify flat wall surface for frameless adhesive-applied boards.

3.2 PREPARATION

- A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.
- B. Remove switchplates, wall plates, and surface-mounted fixtures where tackable wall paneling is applied. Reinstall items on completion of installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Install with top of marker tray at 30 inches (760 mm) above finished floor.
- C. Secure units level and plumb.
- D. Carefully cut holes in boards for thermostats.
- E. Install tackable wall panels in accordance with manufacturer's recommendations on specified substrates with concealed attachments.
 - 1. Fabricate re-wrapped edges where partial panels about each other, or adjacent surfaces or trim.
 - 2. Re-wrap top, bottom or side edges for cutting panels around door or window openings, abutting trim, protruding objects, and at other openings, including x-cut at receptacles, light switches, and other openings.
 - a. Wrap minimum 2 inches (51 mm) around back of panel.
 - b. Carefully cut fiber board, leaving vinyl wallcovering intact. Wrap wallcovering tightly around edge of board and adhere continuously around back of panel with manufacturer's recommended vinyl wallcovering adhesive.

3.4 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.
- D. Break-in slate chalkboards with a chalk and clean treatment.

END OF SECTION

SECTION 10 14 00 - SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cash allowance for signs.
- B. Room and door signs.
- C. Interior directional and informational signs.
- D. Luminous egress path marking and other "glow-in-the-dark" signs.
- E. Emergency evacuation maps.
- F. Building identification signs.
- G. Plaque.
- H. Traffic signs.

1.2 RELATED REQUIREMENTS

- A. Section 05 51 00 - Metal Stairs: Photoluminescent stair nosings.
- B. Section 05 52 00 - Metal Railings: Photoluminescent handrail strips.
- C. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- D. Section 26 05 53 - Identification for Electrical Systems.
- E. Section 26 51 00 - Interior Lighting: Exit signs required by code.

1.3 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. ASTM E2072 - Standard Specification for Photoluminescent (Phosphorescent) Safety Markings; 2014.
- D. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- E. NFPA 170 - Standard for Fire Safety and Emergency Symbols; 2021.
- F. UL 1994 - Luminous Egress Path Marking Systems; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on Drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.

- F. Verification Samples: Submit samples showing colors specified.
- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- H. Manufacturer's Qualification Statement.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Curved Sign Media Suction Cups: One for each 100 signs; for removing media.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.7 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Flat Signs:
 - a. Best Sign Systems, Inc: www.bestsigns.com/#sle.
 - b. Cosco Industries: www.coscoarchitecturalsigns.com/#sle.
 - c. FASTSIGNS: www.fastsigns.com/#sle.
 - d. Inpro: www.inprocorp.com/#sle.
 - e. Mohawk Sign Systems, Inc: www.mohawksign.com/#sle.
 - f. Seton Identification Products: www.seton.com/aec/#sle.
 - 2. Curved Signs:
 - a. FASTSIGNS: www.fastsigns.com/#sle.
 - b. Vista System: www.vistasystem.com/#sle.
 - c. _____.
 - 3. Dimensional Letter Signs:
 - a. Cosco Industries: www.coscoarchitecturalsigns.com/#sle.
 - b. FASTSIGNS: www.fastsigns.com/#sle.
 - c. Inpro: www.inprocorp.com/#sle.
 - 4. Plaques:
 - a. Cosco Industries www.coscoarchitecturalsigns.com/#sle.
 - b. FASTSIGNS: www.fastsigns.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting

requirements, comply with the most comprehensive and specific requirements.

- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
 - 3. Character Height: 1 inch (25 mm).
 - 4. Sign Height: 2 inches (50 mm), unless otherwise indicated.
 - 5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
 - 6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
 - 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 - 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Interior Directional and Informational Signs:
 - 1. Sign Type: Same as room and door signs.
 - 2. Sign Type: Curved signs with engraved panel media as specified.
 - 3. Sizes: As indicated on Drawings.
 - 4. Allow for 20 signs 4 inches high by 16 inches long.
 - 5. Wording of signs is scheduled on Drawings.
 - 6. Where suspended, ceiling mounted, or projecting from wall signs are indicated, provide two-sided signs with same information on both sides.
- D. Luminous Egress Path Marking and Other "Glow-in-the-Dark" Signs: Photoluminescent media.
 - 1. Provide luminous egress path marking as required by local authority having jurisdiction.
 - 2. Allow for total of 100 directional signs, approximately 6 inches (150 mm) square.
 - 3. Allow for 1000 linear feet (305 linear meters) of guidance strips.
 - 4. Provide one numbered seat marker for each seat in auditorium and one numbered row marker for each row, each side of aisles.
- E. Emergency Evacuation Maps:
 - 1. Allow for one map per elevator lobby.
 - 2. Map content to be provided by Architect.
 - 3. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.
- F. Recognition/Donor Panels: Engraved panel media; individual name signs attached with magnetic tape to fixed panel.
 - 1. Dimensions and Number of Name Signs: As indicated on Drawings.
 - 2. Provide all name signs whether engraved or not, for uniform overall appearance.
 - 3. Color: Color as selected.
- G. Building Identification Signs:
 - 1. Use individual metal letters.
 - 2. Mount on outside wall in location indicated on drawings.
- H. Other Dimensional Letter Signs: Wall-mounted.
 - 1. Exterior: Allow for total of 50 letters, 6 inches (150 mm) high, metal.
 - 2. Interior: Allow for total of 50 letters, 6 inches (150 mm) high, metal.
- I. Plaque: See Allowance for details.

J. Traffic Signs: Match campus standards; locate where indicated on Drawings.

2.3 SIGN TYPES

- A. Flat Signs: Signage media without frame.
 - 1. Edges: Square.
 - 2. Corners: Square.
 - 3. Frame Finish: Natural (clear) anodized.
 - 4. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, non-glare on front.
 - 5. Wall Mounting of One-Sided Signs: Tape adhesive.
 - 6. Wall and Ceiling Mounting of Two-Sided Signs: Aluminum wall bracket, powder coated, color selected from manufacturer's standard colors, attached with screws in predrilled mounting holes, set in clear silicone sealant.
 - 7. Suspended Mounting: Stainless steel suspension cables, cable clamps, and ceiling fastener suitable for attachment to ceiling construction indicated.
- B. Radius / Curved Signs: One-piece, curved extruded aluminum media holder securing flat, flexible sign media by curved lip on two sides; other two sides closed by end caps; concealed mounting attachment.
 - 1. Sizes: As indicated on Drawings.
 - 2. Finish: Natural (clear) anodized.
 - 3. Sign Orientation: Curved in horizontal section.
 - 4. End Caps: Aluminum with finish matching frame and stainless steel screw attachment.
 - 5. End Caps: Plastic, color selected from manufacturer's standard colors, paintable.
 - 6. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, non-glare on front.
 - 7. Wall Mounting of One-Sided Signs: Mechanical anchorage, with predrilled holes, and set in clear silicone sealant.
 - 8. Wall and Ceiling Mounting of Two-Sided Signs: Aluminum wall bracket, powder coated, color selected from manufacturer's standard colors, attached with screws in predrilled mounting holes, set in clear silicone sealant.
 - 9. Mounting of Floor Mounted Pylon Signs: Oval shaped steel base anchored to floor.
 - 10. Suspended Mounting: Stainless steel suspension cables, cable clamps, and ceiling fastener suitable for attachment to ceiling construction indicated.
 - 11. Directories: For customer-produced media; provide divider strips.
- C. Color and Font: Unless otherwise indicated:
 - 1. Character Font: Helvetica, Arial, or other sans serif font.
 - 2. Character Case: Upper case only.
 - 3. Background Color: Clear.
 - 4. Character Color: Contrasting color.

2.4 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
 - 1. Total Thickness: 1/16 inch (1.6 mm).
- B. Injection Molded Panels: One-piece acrylic plastic, with raised letters and braille.
 - 1. Total Thickness: 1/8 inch (3 mm).
- C. Applied Character Panels: Acrylic plastic base, with applied acrylic plastic letters and braille.
 - 1. Total Thickness: 1/8 inch (3 mm).
 - 2. Letter Thickness: 1/8 inch (3 mm).
 - 3. Letter Edges: Square.

2.5 NON-TACTILE SIGNAGE MEDIA

- A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:
 - 1. Sign Color: Clear.
 - 2. Total Thickness: 1/8 inch (3 mm).
- B. Sand Blasted Plastic Panels: High gloss acrylic plastic; letters sand blasted to dull sheen:
 - 1. Total Thickness: 1/8 inch (3 mm).

2.6 PLAQUES

- A. Metal Plaques:
 - 1. Metal: Aluminum casting.
 - 2. Metal Thickness: 1/8 inch (3 mm), minimum.
 - 3. Size: As indicated on drawings.
 - 4. Text and Typeface:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - b. Character Case: Upper case only.
 - c. Character Color: Contrast with background color.
 - 5. Border Style: As indicated on drawings.
 - 6. Background Texture: Ripple.
 - 7. Surface Finish: Brushed, satin.
 - 8. Painted Background Color: Light oxide stain.
 - 9. Protective Coating: Manufacturer's standard clear coating.
 - 10. Product: _____.
 - 11. Mounting: Rosettes and toggle bolts.
 - a. Rosette Style: Floral.
 - b. Rosette Diameter: 3/8 inch (10 mm).

2.7 DIMENSIONAL LETTERS

- A. Metal Letters:
 - 1. Metal: Aluminum casting.
 - 2. Metal Thickness: 1/8 inch minimum (3 mm).
 - 3. Letter Height: _____ inches (_____ mm).
 - 4. Text and Typeface:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - b. Character Case: Upper case only.
 - 5. Finish: Brushed, satin.
 - 6. Mounting: Tape adhesive.
- B. Plastic Letters:
 - 1. Material: Injection molded plastic.
 - 2. Color: As selected by Architect.
 - 3. Product: _____.
 - 4. Mounting: Tape adhesive.

2.8 PHOTOLUMINESCENT MEDIA

- A. Stair Identification Signs: Nonflexible photoluminescent sign with tactile raised numbers and Braille markings.
 - 1. Comply with UL 1994 and ASTM E2072.
 - 2. Size: 12 inches by 18 inches (305 mm by 457 mm).
 - 3. Mounting: As recommended by manufacturer for material selected.
 - 4. Products:
 - a. Safe-T-Nose, LLC; Photoluminescent Stair Identification Sign (ISID):
www.safetnose.com/#sle.

- b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- B. Directional Signs: Acrylic photoluminescent square.
 - 1. Comply with NFPA 170, UL 1994, and ASTM E2072.
 - 2. Symbol: Running man right.
 - 3. Size: 5 inches by 5 inches (127 mm by 127 mm).
 - 4. Mounting: Peel-and-stick.
 - 5. Products:
 - a. Safe-T-Nose, LLC; Photoluminescent Directional Sign (DRMR):
www.safetnose.com/#sle.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- C. Extruded Aluminum Guidance Strips:
 - 1. Comply with UL 1994 and ASTM E2072.
 - 2. Width: 1/2 inch (12.5 mm).
 - 3. Mounting: As recommended by manufacturer for material selected.
 - 4. Products:
 - a. _____.
 - b. _____.
 - c. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- D. Sheet Aluminum Guidance Strips:
 - 1. Comply with UL 1994 and ASTM E2072.
 - 2. Width: 1/2 inch (12.5 mm).
 - 3. Mounting: As recommended by manufacturer for material selected.
- E. High-Impact Plastic Guidance Strips:
 - 1. Comply with UL 1994 and ASTM E2072.
 - 2. Width: 1 inch (26 mm).
 - 3. Mounting: As recommended by manufacturer for material selected.
 - 4. Products:
 - a. Safe-T-Nose, LLC; Photoluminescent Perimeter Strips (STNF):
www.safetnose.com/#sle.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- F. Polyester Tape Guidance Strips:
 - 1. Comply with UL 1994 and ASTM E2072.
 - 2. Width: 1/2 inch (12.5 mm).
 - 3. Protection: Temporary protective cover.
 - 4. Products:
 - a. Safe-T-Nose, LLC; Photoluminescent Exit Path/Perimeter Markings (S9203P):
www.safetnose.com/#sle.
 - b. _____.
 - c. _____.
 - d. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- G. Obstruction Strips: Black/luminous stripe marking on sheet aluminum.
 - 1. Comply with UL 1994 and ASTM E2072.
 - 2. Width: 1/2 inch (12.5 mm).
 - 3. Mounting: As recommended by manufacturer for material selected.
 - 4. Products:
 - a. Safe-T-Nose, LLC; Photoluminescent Obstruction Markings (0150):
www.safetnose.com/#sle.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
- H. Photoluminescent Stair Nosings: Factory fabricated aluminum extrusion with replaceable embedded photoluminescent and slip-resistant strip.

1. Comply with UL 1994 and ASTM E2072.
2. Finish: Anodized.
3. Color: As selected by Architect from manufacturer's standard range.
4. Mounting: Provide manufacturer approved field applied adhesive, factory applied adhesive, and mechanical fasteners.

2.9 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Exposed Screws: Chrome plated.
- C. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION

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SECTION 10 21 13.17 - PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Phenolic toilet compartments.
- B. Urinal screens.

1.2 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing: Concealed steel support members.
- B. Section 05 50 00 - Metal Fabrications: Concealed steel support members.
- C. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- D. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.
- E. Section 10 28 19 - Tub and Shower Enclosures: Shower compartment construction.

1.3 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- D. Samples: Submit two samples of partition panels, 6 by 6 inches (150 by 150 mm) in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. All American Metal Corp - AAMCO: www.allamericanmetal.com/#sle.
 - 2. ASI Accurate Partitions: www.asi-accuratepartitions.com/#sle.
 - 3. ASI Global Partitions: www.asi-globalpartitions.com/#sle.
 - 4. Partition Systems International of South Carolina: www.psisc.com/#sle.
 - 5. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 PHENOLIC TOILET COMPARTMENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and panels made of solid phenolic core panels with integral melamine finish, floor-mounted, headrail-braced.
 - 1. Core Color: Black.
 - 2. Face Colors: Williamsburg Cherry for doors, Williamsburg Cherry for panels.

- B. Doors:
 - 1. Thickness: 3/4 inch (19 mm).
 - 2. Width: 24 inch (610 mm).
 - 3. Width for Wheelchair Accessible Compartments: 36 inch (915 mm), out-swinging.
 - 4. Height: 72 inch (1829 mm).
- C. Panels:
 - 1. Thickness: 1/2 inch (13 mm).
 - 2. Height: 72 inch (1829 mm).
 - 3. Width: As indicated on drawings.
- D. Pilasters:
 - 1. Thickness: 3/4 inch (19 mm).
 - 2. Width: As required to fit space; minimum 3 inch (76 mm).
- E. Urinal Screens: Without doors; to match compartments; mounted to wall with two panel brackets with vertical support/bracing same as compartments.

2.3 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch (76 mm) high, concealing floor fastenings.
 - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Pilaster Ceiling Attachment:
 - 1. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.
- C. Head Rails: Hollow anodized aluminum, 1 inch by 1-1/2 inch (25 mm by 38 mm) size, with anti-grip profile and cast socket wall brackets.
- D. Wall and Pilaster Brackets: Polished stainless steel; manufacturer's standard type for conditions indicated on drawings.
- E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
- F. Door Hardware: Polished stainless steel:
 - 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
 - 2. Nylon bearings.
 - 3. Door Latch: Slide type with exterior emergency access feature.
 - 4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 - 5. Coat Hook: Refer to Section 10 28 00 - Toilet, Bath, and Laundry Accessories .
 - 6. Provide door pull for outswinging doors.
- G. Toilet Partition Suspension Members: Refer to Section 05 50 00 - Metal Fabrications.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch (9 mm to 13 mm) space between wall and panels and between wall and end pilasters.

- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch (6 mm).
- B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.4 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

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SECTION 10 21 23 - CUBICLE CURTAINS AND TRACK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended, overhead curtain track and guides.
- B. Surface-mounted, overhead curtain track and guides.
- C. Cubicle curtains.
- D. Blackout curtains.

1.2 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Above ceiling track supports.
- B. Section 06 10 00 - Rough Carpentry: Above ceiling blocking and track supports for track.
- C. Section 09 51 00 - Acoustical Ceilings: Suspended ceiling system to support track.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data for curtain fabric characteristics and _____.
- C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.
- D. Samples: Submit 12 by 12 inch (300 by 300 mm) sample patch of curtain cloth with representative top, bottom, and edge hem stitch detail, heading with reinforcement and carrier attachment to curtain header.
- E. Samples: Submit 12 inch (300 mm) sample length of curtain track including typical splice, wall and ceiling hanger, and escutcheon.
- F. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and _____.
- G. Maintenance Data: Include recommended cleaning methods and materials and stain removal methods.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Curtains: Two of each type and size.
 - 3. Extra Carriers: Ten.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept curtain materials on site and inspect for damage.
- B. Store curtain materials on site and deliver to Owner for installation when requested.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

1. A. R. Nelson Co: www.arnelson.com/#sle.
2. Construction Specialties, Inc: www.c-sgroup.com/#sle.
3. Imperial Fastener Co., Inc: www.imperialfastener.com/#sle.
4. Inpro: www.inprocorp.com/#sle.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 TRACKS AND TRACK COMPONENTS

- A. Tracks: Extruded aluminum sections; one piece per track run.
1. Profile: Channel.
 2. Mounting: Surface.
 3. Structural Performance: Capable of supporting vertical test load of 50 lbs (23 kg) without visible deflection of track or damage to supports, safely supporting moving loads, and sufficiently rigid to resist visible deflection and without permanent set.
 4. Track End Stop: To fit track section.
 5. Track Bends: Minimum 12 inch (300 mm) radius; fabricated without deformation of track section or impeding movement of carriers.
 6. Suspension Rods: Tubular aluminum sections, sized to support design loads and designed to receive attachment from track and ceiling support.
 7. Escutcheons: Where suspension rod meets finished ceiling or structure, provide escutcheons to match rod finish.
 8. Finish on Exposed Surfaces: White enamel.
 9. Products:
 - a. Inpro.
- B. Curtain Carriers: Nylon rollers, size and type compatible with track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal.
1. Provide 3 carriers per foot of track length (10 carriers per meter of track length)
- C. Wand: Aluminum, attached to lead carrier, for pull-to-close action.
- D. Installation Accessories: Types required for specified mounting method and substrate conditions.

2.3 CURTAINS

- A. Cubicle Curtains:
1. Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 2. Inherently flame resistant or flameproofed; capable of passing NFPA 701 test.
 3. Material: Close weave polyester; anti-bacterial, self deodorizing, sanitized, and preshrunk.
 4. Color/Pattern: Stingray / Simplicity.
 5. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, manufacturer's standard color.
 6. Attachment of Curtain Fabric to Open Mesh Cloth: Manufacturer's standard sewn seam.
 7. Basis of Design Products:
 - a. Clickeze Privacy Curtains manufactured by Inpro.
- B. Curtain Fabrication:
1. Width of curtain to be 10 percent wider than track length.
 2. Length of curtain to end 15 inches (380 mm) above finished floor.
 3. Railroad fabric without vertical seams.
 4. Pattern match fabric with vertical seams.
 5. Include open mesh cloth at top 20 inches (508 mm) of curtain for room air circulation, attached to curtain as specified above.
 6. Curtain Heading: Fabric band matching curtain panel with metal grommet holes for carriers spaced 6 inches (150 mm) on center.

7. Seams and Hems: Manufacturer's standard fabrication method for securely sewn and finished seams and hems.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.
- B. Verify that field measurements are as indicated.

3.2 INSTALLATION

- A. Install curtain track to be secure, rigid, and true.
- B. Refer to Section 05 50 00 - Metal Fabrications for track supports above ceiling.
- C. Refer to Section 06 10 00 - Rough Carpentry for blocking and track supports above ceiling.
- D. Secure track to ceiling system.
- E. Install end cap and stop device.
- F. Install curtains on carriers ensuring smooth operation.

END OF SECTION

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SECTION 10 22 13 - WIRE MESH PARTITIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wire mesh systems for walls, ceilings, and stairways.

1.2 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware: Cylinders for locksets.
- B. Section 09 90 00 - Painting and Coating.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- D. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel; 2020.
- E. ASTM A580/A580M - Standard Specification for Stainless Steel Wire; 2018.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023.
- G. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Provide data for mesh materials, finishes.
- C. Shop Drawings: Indicate plan and vertical dimensions, elevations, component details; head, jamb, and sill details; location of hardware. Provide component details, anchorage, and type and location of fasteners.
 - 1. Show field measurements on shop drawings.
- D. Samples: Submit two, 3 by 3 inches in size, illustrating mesh material. Submit samples of hinge and latchset illustrating style, color, and finish. Incorporate sample into the work.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- F. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
 - 1. Member firm of the Woven Wire Products Association (WWPA).
- B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
1. Acorn Wire and Iron Works, Inc: www.acornwire.com/#sle.
 2. The G-S Company: www.g-sco.com/#sle.
 3. Miller Wire Works, Inc: www.millerwireworks.com/#sle.
 4. Spaceguard Products: www.spaceguardproducts.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 WIRE MESH PARTITIONS

- A. Wire Mesh Partitions: Factory-fabricated modular assemblies of panels, doors, anchors, hardware, and accessories as required to provide a complete system.
1. Design Criteria:
 - a. Design partition system to provide for movement of components without damage, undue stress on fasteners or other detrimental effects, when subject to design loads.
 - b. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
 - c. Comply with applicable code for wire mesh opening size.

2.3 COMPONENTS

- A. Woven Wire Mesh: Standard duty.
1. Material: ASTM A510/A510M uncoated crimped steel wire.
 2. Wire Size: 10 gauge, 0.135 inch (3.5 mm).
 3. Mesh Opening Size: 1-1/2 inch (38 mm) diamond shape.
 4. Mesh Weave: inter-crimped.
- B. Framing and Support Members:
1. Material: ASTM A36/A36M steel shapes.
 2. Framing, Corner Posts, and Intermediate Support Members: Manufacturer's standard sizes for system specified and as indicated on drawings.
 3. Vertical Stiffeners: As required for partitions greater than 144 inches (3658 mm) in height.
- C. Doors: Same material as partitions, fully framed; manufacturer's standard construction and hardware for swing operation.
1. Locking: Integrated padlock hasps for padlocks provided by Owner.
 2. Locking: Mortise type cylinder locks, keyed on outside, operated by _____ inside.
 3. Locking: Mortise type cylinder locks as specified in Section 08 71 00 - Door Hardware.
- D. Service Window: Same material as partitions; manufacturer's standard construction for lift-up operation.
- E. Sheet Metal Base Panel: ASTM A1008/A1008M, cold rolled steel sheet.
- F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

2.4 FASTENERS

- A. Bolts, Nuts and Washers: Hot dip galvanized.
- B. Anchorage Devices: Provide power driven, powder actuated, and drilled expansion bolts.
- C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of structure.

2.5 ACCESSORIES

- A. Bracing: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.
- B. Plates, Gussets, Clips: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.
- C. Post Caps: Manufacturer's standard.
- D. Floor and Ceiling Pilaster Shoe: Manufacturer's standard.
- E. Floor Base: Manufacturer's standard.

2.6 FABRICATION

- A. Fit and assemble in largest practical sections for delivery to site, ready for installation.
- B. Make exposed joints flush or tight.
- C. Provide mortised and tenoned joints for framing members.
- D. Provide components required for anchorage to adjacent construction.
- E. Frame openings made for penetrating mechanical and electrical components.

2.7 FINISHES

- A. Factory Finish: Manufacturer's standard powder coat finish.
 - 1. Color: As selected by Architect.
- B. Field Painted Finish: As specified in Section 09 90 00 - Painting and Coating.
- C. Galvanized Finish: In accordance with requirements of ASTM A123/A123M.
- D. Leave components unfinished.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that substrate surfaces and required openings are ready to receive work.

3.2 PREPARATION

- A. Clean substrate surfaces.
- B. Clean partition surfaces of rust, scale, grease, and foreign matter prior to field finishing as specified in Section 09 90 00 - Painting and Coating.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install items plumb and level, accurately fitted, free from distortion or defects.
- C. Perform field welding in accordance with AWS D1.1/D1.1M.
- D. After installation, touch-up field welds scratched or damaged surfaces with shop applied finish.

3.4 TOLERANCES

- A. Maximum Variation From Plumb or Level: 1/4 inch (6 mm).
- B. Maximum Misalignment From True Position: 1/4 inch (6 mm).

3.5 ADJUSTING

- A. Adjust doors to achieve free movement.

3.6 CLEANING

- A. Remove temporary protection to prefinished surfaces.

END OF SECTION

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Corner guards.
- B. Related Requirements:
 - 1. Section 05 50 00 - Metal Fabrications: Anchors for attachment of work of this section, concealed in wall.
 - 2. Section 06 10 00 - Rough Carpentry: Blocking for wall and corner guard anchors.
 - 3. Section 08 71 00 - Door Hardware: Standard protection plates and trim.
 - 4. Section 09 21 16 - Gypsum Board Assemblies: Placement of supports in stud wall construction.

1.3 REFERENCE STANDARDS

- A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2023.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Shop Drawings: Include plans, elevation, sections, and attachment details.
- D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
- E. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.

- E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.6 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 PERFORMANCE CRITERIA

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.

2.3 PRODUCT TYPES

- A. Corner Guards - Surface Mounted, PETG:
 - 1. Material: Polyethylene terephthalate (PET or PETG); PVC-free with full height extruded aluminum retainer.
 - 2. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
 - 3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 4. Width of Wings: 2 inches.
 - 5. Corner: 1/4 inch radius.
 - 6. Color: #934 Pearl.
 - 7. Projection From Wall to Outside of Guard: 3/8 inch (3/8 inch (9.5 mm).
 - 8. Length: One piece, 96 inches (2438 mm).
 - 9. Preformed end caps.
 - 10. Mounting: Continuous aluminum retainer with countersunk holes.
- B. Corner Guards - Surface Mounted, Stainless Steel:
 - 1. Basis of Design: Korogard Stainless Steel Corner Guard model GS15 manufactured by Koroseal Interior Products, Inc.
 - 2. Material: Type 304 stainless steel, No. 4 finish, 16 gauge.
 - 3. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
 - 4. Width of Wings: 2 inches (51 mm) and 6 inches (152 mm), as indicated on Drawings.
 - 5. Corner: Square.
 - 6. Length: One piece, as indicated on Drawings.
 - 7. Mounting: Countersunk screws through factory-drilled holes.

2.4 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Pre-drill holes for attachment.
- C. Form end trim closure by capping and finishing smooth.

2.5 SOURCE QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements, for additional requirements.

- B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Verify that substrate surfaces for adhered items are clean and smooth.
 - 1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.
- D. Start of installation constitutes acceptance of project conditions.

3.2 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Position corner guard 4 inches (102 mm) above finished floor to 96-inches.

3.3 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch (6 mm).
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

3.4 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

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SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements including but not limited to:
 - 1. Washroom accessories.
 - 2. Toilet accessories.
 - 3. Shower room accessories.
 - 4. Warm air dryers.
 - 5. Childcare accessories.
 - 6. Custodial accessories.
 - 7. Accessories necessary for a complete installation.

1.2 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023.
- E. ASTM B16/B16M - Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines; Current.
- F. ASTM B19 - Standard Specification for Cartridge Brass Sheet, Strip, Plate, Bar, and Disks; Current.
- G. ASTM B30 - Standard Specification for Copper Alloys in Ingot and Other Remelt Forms; Current.
- H. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.
- I. ASTM F446 - Standard Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area; 2019.
- J. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2022.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. Texas Accessibility Standards (TAS) - 2012 Texas Accessibility Standards (TAS); 2012.

1.3 PERFORMANCE REQUIREMENTS

- A. Grab Bars:
 - 1. Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges. The space around the grab bars shall be as follows:
 - a. 1-1/2 inches between the grab bar and the wall.
 - b. 1-1/2 inches minimum between the grab bar and projecting objects below and at the ends.
 - c. 12 inches minimum between the grab bar and projecting objects above.
 - 2. Grab Bars shall be designed to resist a single concentrated load of 250 lbs. applied in any direction at any point of the grab bar such as to produce the maximum load effect.

1.4 SUBMITTALS

- A. Product Data: Technical Data including construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 1. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 2. Include electrical characteristics.
- B. Samples: Provide a sample to demonstrate each exposed product finish specified.
- C. Product Schedule: Show types, quantities, sizes, and installation locations by room of each accessory required. Identify locations using room designations indicated.
- D. Maintenance Data: Submit for inclusion in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Accessibility Requirements: Comply with applicable requirements.
 - a. ICC/ANSI A117.1 Accessible and Useable Building and Facilities.
 - b. Texas Accessibility Standards (TAS).
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Source Limitations: Obtain products from single source from single manufacturer.

1.6 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.7 WARRANTY

- A. Mirrors: Written warranty signed by manufacturer in which manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work.
 - 1. AJW Architectural Products.
 - 2. American Specialties, Inc.
 - 3. Bobrick Washroom Equipment, Inc.
 - 4. Bradley Corporation.
 - 5. Brey-Krause Manufacturing Co.
 - 6. GAMCO Specialty Accessories; a division of Bobrick.
 - 7. Georgia Pacific.
 - 8. Tubular Specialties Manufacturing, Inc.
- B. Substitutions: Refer to 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 MATERIALS

- A. Stainless Steel: ASTM A666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated
- B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness
- D. Galvanized Steel Sheet: ASTM A653/A653M, with G60 (Z180) hot dip zinc coating
- E. Galvanized Steel Mounting Devices: ASTM A153/A153M, hot dip galvanized after fabrication
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed
- G. Mirrors: ASTM C1503, Mirror Glazing Quality, clear glass mirrors, nominal 6.0 mm thick

2.3 COMPONENTS

- A. Underlavatory Guard: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 - 1. Material and Finish: Antimicrobial, molded plastic, white

2.4 FABRICATION

- A. Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items. Remove temporary labels and protective coatings. Clean and polish exposed surfaces according to manufacturer's written recommendations.

PART 4 SCHEDULE

4.1 TOILET ACCESSORY SCHEDULE

- A. TA-1C - Soap Dispensers – Counter-Mounted:
 - 1. Mounting: Undercounter.
 - 2. Basis of Design: Bobrick B-8226.
 - 3. Locations: Where indicated on Drawings.
- B. TA-1W - Soap Dispensers – Wall-Mounted:
 - 1. Mounting: Surface.
 - 2. Basis of Design: Bobrick B-2111.
 - 3. Locations: Where indicated on Drawings.
- C. TA-2 - Lavatory Mirrors, Typical:

1. Mounting: Surface.
 2. Basis of Design: Bobrick B-290.
 3. Size: 24 inches by 36 inches.
 4. Location: At each lavatory.
- D. TA-2F - Full-Length Mirrors:
1. Mounting: Surface.
 2. Basis of Design: Bobrick B-290.
 3. Size: 24 inches by 72 inches.
 4. Location: Where indicated on Drawings.
- E. TA-3 - Toilet Paper Dispensers:
1. Mounting: Surface.
 2. Basis of Design: Bobrick B-265.
 3. Locations: At each water closet.
- F. TA-4 - Paper Towel Dispensers:
1. Mounting: Surface.
 2. Basis of Design: Bobrick B-262.
 3. Locations: Where indicated on Drawings.
- G. TA-5 - Grab Bars: (At Wheelchair-Accessible Water Closets):
1. Size/Finish: 1-1/2 inch diameter satin stainless steel.
 2. Basis of Design: Bobrick B-6806.
 3. Mounting: Attach with concealed mounting kit. Mount parallel to floor.
 4. Location: At each wheelchair-accessible water closet.
- H. TA-6 - Sanitary Napkin Dispensers:
1. Mounting: Surface.
 2. Basis of Design: Bobrick B-2706.
 3. Operation: Single coin / Double coin - (25/50 cents).
 4. Capacity: 20 Napkins/ 30 Tampons.
 5. Locations: At each women's toilet room.
- I. TA-7 - Sanitary Napkin Disposal:
1. Mounting: Surface.
 2. Basis of Design: Bobrick B-270.
 3. Locations: Where indicated on Drawings.
- J. TA-8 - Shelf with Mop and Broom Holders and Hooks:
1. Mounting: Surface.
 2. Model No.: B-239 x 34.
 3. Capacity: Four hooks, three mop holders.
 4. Locations: Mop sink at each custodial rooms.
- K. TA-9 - Grab Bars: (At Accessible Shower):
1. Mounting: Surface.
 2. Basis of Design: Bobrick B-6861 modified (24 x 16).
 3. Locations: At each accessible shower stall.
- L. TA-10A - Folding Benches: Adult Height:
1. Mounting: Surface, reversible.
 2. Basis of Design: Bobrick B-5181.
 3. Locations: Where indicated on Drawings.
- M. TA-10C - Folding Benches, Child Height (15 inch (375 mm) seat height):
1. NOT USED.
- N. TA-11 - Clothing Hook:

1. Mounting: Surface.
 2. Basis of Design: Bobrick B-6717.
 3. Locations: All shower locations.
 4. Toilet and Shower Partitions: If toilet and shower partitions are utilized, hooks are to be provided by the partition manufacturer(s) as part of their hardware package.
- O. TA-12 - Shower Curtains, Rods and Hooks:
1. Basis of Design:
 - a. Rods: Bobrick B-6107 (36 inches or as indicated).
 - b. Curtains: Bobrick B-204-2 (42 inches x 72 inches or as required).
 - c. Hooks: Bobrick B-204-1.
 2. Mounting/Locations: Where indicated on Drawings.
- P. TA-13 - Electric Hand Dryers:
1. Mounting: Semi-Recessed, maximum 3-9/16 inch recess.
 2. Basis of Design: Bobrick B-750, white.
 3. Voltage: 120 volt, single phase.
 4. Location: Where indicated on Drawings.
- Q. TA-14 - Paper Towel Dispenser/Trash Receptacle Combination:
1. Mounting: Surface.
 2. Basis of Design: Bobrick B-3949.
 3. Locations: Where indicated on Drawings.
- R. TA-15 - Grab Bars: (At Ambulatory-Accessible Toilet Compartments):
1. Size/Finish: 1-1/2 inch diameter satin stainless steel, lengths as indicated in drawings.
 2. Basis of Design: Bobrick B-6806.
 3. Mounting: Attach with concealed mounting. Mount parallel to floor.
 4. Location: At each ambulatory-accessible toilet compartment.
- S. TA-16C - Child Changing Station:
1. Type: Horizontal station to accommodate infants and toddlers.
 2. Basis of Design:
 - a. Model KB310-SSRE manufactured by Koala Kare Products, a division of Bobrick.
 3. General Requirements:
 - a. Comply with applicable accessibility and regulatory requirements..
 - b. Comply with with ASTM F2285.
 - c. Provide universal instruction graphics and safety messages in multiple languages.
 - d. Provide replacable restraining straps.
 4. Construction and Features:
 - a. Antifungal to comply with ASTM standards.
 - b. Dimensions: 41-5/16 inches wide by 26-7/32 inches high by 2-23/32 inches deep.
 - c. Handles: Station shall have two solid handles that allow operation with less than 5 lbs. of force. Handles rest below 27 inches for cane detection when unit is in the down position.
 - d. Front Panel shall be deep drawn, one-piece, seamless, 18-8, Type 304, 20 gauge (0.91 mm) stainless steel with satin finish and laser etched logo with rounded corners.
 - e. Aesthetics: Unit shall have no plastic covering or visible plastic on the front of the unit and no adhesive labels applied to the front panel.
 - f. Flange: Deep drawn, one-piece seamless, 18-8, Type 304, 18 gauge (1.2 mm) stainless steel with satin finish. Flange edges and corners shall have radii that complements the arc on the top, bottom, and side edges of the front panel.
 - g. Frame and Hinge Mechanism: Concealed 11-gauge chassis, compromised of 1 inch diameter integral steel-tubing that supports the changing bed and interacts with 11 gauge steel wall mounting bracket to provide steel-on-steel hinge stop. The wall

- frame shall serve as wall-mounting bracket.
- h. External Diaper Bag Hook: 18-8, Type 304, 3/4 inch (19mm) diameter, wall-mounted, solid stainless steel rod with satin-finish.
- i. Bed Surface: injection molded polypropylene with antimicrobial additive, ISO 22196 tested for efficacy.
- j. Surface is contoured, concave and smooth. Bed surface shall be minimum 535 sq. in.
- k. Performance: Unit shall have minimal deflection from 90 degrees with a 200 lbs. static load placed in the center of the changing surface.
- l. Dual Cavity Dispenser: Includes integral spring tab to make dispensing bed liners and diaper disposal sacks easier. Total 50 liner capacity. Equipped with tumbler lock, keyed alike Bobrick restroom accessories.
- m. Operation: Concealed pneumatic cylinder providing controlled opening and closing of the changing station bed.
- 5. Finish: Manufacturer's standard stainless steel.
- 6. Location: Where indicated on Drawings.
- T. TA-16A - Adult Changing Station:
 - 1. NOT USED.
- U. TA-17R - Trash Receptacle, Recessed:
 - 1. Mounting: Recessed.
 - 2. Basis of Design: Bobrick B-3644.
 - 3. Locations: As indicated on Drawings.
- V. TA-17U - Trash Receptacle Undercounter:
 - 1. Mounting: Free standing.
 - 2. Basis of Design: Bobrick B-2280.
 - 3. Locations: As indicated on Drawings.
- W. TA-18 - Vertical Grab Bar:
 - 1. Mounting: Surface.
 - 2. Basis of Design: Bobrick B-6806x18.
 - 3. Locations: As indicated on Drawings.
- X. TA-19 – Water Closet Cover Dispenser:
 - 1. Mounting: Recessed.
 - 2. Basis of Design: Bobrick B-301.
 - 3. Locations: At each water closet.
- Y. TA-20 - Folding Utility Shelf:
 - 1. Mounting: Surface.
 - 2. Basis of Design: Bobrick B-287.
 - 3. Locations: At each toilet compartment.

END OF SECTION

SECTION 10 43 00 - EMERGENCY AID SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Automated external defibrillators (AEDs).
- B. Automated external defibrillator (AED) cabinets.
- C. Emergency oxygen tank cabinets.
- D. AED and emergency oxygen tank cabinets.
- E. First aid cabinets.
- F. Bleeding control cabinets.
- G. Key boxes.
- H. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 09 90 00 - Painting and Coating: Field paint finish.

1.3 DEFINITIONS

- A. Automated External Defibrillator (AED): A Food and Drug Administration (FDA)-approved portable device, which automatically analyzes the heart rhythm and recognizes the presence of ventricular fibrillation and/or tachycardia. If defibrillation is warranted, the AED automatically charges and prompts (visual and/or audio) the operator to deliver an electrical shock.

1.4 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide AED operational features, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test schedules and recertification requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Automated External Defibrillators (AEDs):
 - 2. Emergency Aid Cabinets and Accessories:
 - a. Activar Construction Products Group, Inc. - JL Industries; LifeStart 1400 Series AED Cabinet: www.activarcpg.com/#sle.
 - b. Modern Metal Products, a division of Technico, Inc: www.modern-metal.com/#sle.
 - 3. Key Boxes:

- a. Knox Company: www.knoxbox.com/#sle.
- 4. AED Floor Signs:
 - a. Brimar Industries, Inc: www.brimar.com/#sle.
 - b. Insite Solutions, LLC: www.stop-painting.com/#sle.
- 5. AED Floor Marking Kits:
 - a. Insite Solutions, LLC: www.stop-painting.com/#sle.

2.2 AUTOMATED EXTERNAL DEFIBRILLATORS (AEDS)

- A. Automated External Defibrillators (AEDs) - General: FDA approval required.
 - 1. Automated external defibrillators (AEDs) shall be provided by Owner.

2.3 EMERGENCY AID CABINETS

- A. Type: Automated external defibrillator (AED), AED and emergency oxygen, Emergency oxygen, First aid, and Bleeding control.
- B. Cabinet Construction: Non-fire-rated.
 - 1. Formed primed steel sheet; 0.036 inch (0.9 mm) thick base metal.
- C. Cabinet Configuration: Recessed, Semi-recessed, or Surface-mounted type as indicated on Drawings..
 - 1. Size each cabinet to accommodate AED, AED and oxygen tank, oxygen tank, first aid kit, or bleeding control kit as indicated on Drawings.
 - 2. Trim:
 - a. At Recessed Cabinets: Trimless type.
 - b. At Recessed Cabinets: Flat square edge, with ____ inch (____ mm) wide face.
 - c. Projected Trim at Recessed and Semi-Recessed: Returned to wall surface, with ____ inch (____ mm) projection, and ____ inch (____ mm) wide face.
 - 3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- D. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with wire pull handle and nylon catch. Hinge door for 180 degree opening with two butt hinges.
- E. Door Glazing: Tempered glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.
- F. Cabinet Mounting Hardware: Appropriate to cabinet, with predrilled holes for placement of anchors.
- G. Fabrication: Weld, fill, and grind components smooth.
- H. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
- I. Finish of Door Pull or Handle: Stainless steel.
- J. Finish of Cabinet Interior: White powder coat.

2.4 KEY BOXES

- A. Basis of Design: 3200 Series manufactured by Knox Company.
- B. Mounting: Fully-recessed, as indicated on drawings. Surface mounted units are not acceptable.
- C. Finish: As selected by Architect..

2.5 ACCESSORIES

- A. Theft Alarm: Battery operated audible and strobe light alarm, 10 second delay for disarming, activated by opening cabinet door. Alarm deactivated when door is closed.
- B. Alarm Contacts: Contact devices.
 - 1. Magnetic door contact for existing alarm systems.
- C. Plastic Wall Signage: Flat style.

- D. AED and Oxygen Floor Signs:
 - 1. Floor Sign: 17-1/2 inch (445 mm) diameter vinyl sign with "AED OXYGEN" and AED icon.
- E. AED Floor Marking Kits:
 - 1. Floor Marking Tape for AED Access Identification: Self-adhesive vinyl or polyester tape with overlamine, 2 inches (51 mm) wide, with "DO NOT BLOCK" on the 36 inch (914 mm) side strips and "AED" and AED icon on the 24 inch (610 mm) middle strip.
 - 2. Floor Sign: 17-1/2 inch (445 mm) diameter vinyl sign with "AED" and AED icon.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. AED Installation:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Install cabinets plumb and level in wall openings, ____ inches (____ mm) from finished floor to inside bottom of cabinet.
 - 3. Secure rigidly in place.
 - 4. Place AEDs in cabinets.
- B. Wall Signs:
 - 1. Location: Where indicated on Drawings.
 - 2. Apply on walls after field painting is completed and has been accepted.
- C. Cabinet Lettering:
 - 1. Location: Face of door framing.
- D. Key Box Installation:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Location: As indicated on Drawings or as directed by Authorities Having Jurisdiction (AHJ).

3.3 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust doors to operate smoothly without binding.
- C. On completion of installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes. Replace products that cannot be restored to factory-finished appearance. Use materials and procedures recommended by cabinet manufacturer.

3.4 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures for closeout submittals.
- B. Refer to Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Demonstrate proper operation of AED to Owner's designated representative.

END OF SECTION

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SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire extinguishers.
 - 2. Fire extinguisher cabinets.
 - 3. Accessories.
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
 - 2. Section 09 90 00 - Painting and Coating: Field paint finish.

1.2 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- B. FM (AG) - FM Approval Guide; Current Edition.
- C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.3 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, rough-in measurements for recessed cabinets, locations of individual fire extinguishers, mounting measurements for wall bracket, installation procedures, and accessories required for complete installation.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Provide FM Approvals for the following:
 - 1. Multipurpose Dry Chemical Fire Extinguishers.
- G. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.4 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Fire Extinguishers:
 - a. Ansul, a brand of Tyco Fire Protection Products, a division of Johnson Controls International: www.ansul.com/#sle.
 - b. JL Industries, an Activar Construction Products Group, Inc. brand: www.activarcpg.com/#sle.
 - c. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.

- d. Nystrom, Inc: www.nystrom.com/#sle.
 - e. Oval Fire Products: www.ovalfireproducts.com/#sle.
 - f. Potter-Roemer, a member of Morris Group International: www.potterroemer.com/#sle.
 - g. Pyro-Chem, a division of Johnson Controls International: www.pyrochem.com/#sle.
2. Fire Extinguisher Cabinets and Accessories:
- a. JL Industries, an Activar Construction Products Group, Inc. brand: www.activarcpg.com/#sle.
 - b. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
 - c. Larsen's Manufacturing Co., a member of Morris Group International: www.larsensmfg.com/#sle.
 - d. Nystrom, Inc: www.nystrom.com/#sle.
 - e. Oval Fire Products: www.ovalfireproducts.com/#sle.
 - f. Potter-Roemer, a member of Morris Group International: www.potterroemer.com/#sle.

2.2 FIRE EXTINGUISHERS

- A. Existing fire extinguisher for reuse:
 - 1. Verify fire extinguisher is in good working order prior to installation. If not, notify Owner.
- B. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- C. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Basis of Design: Cosmic 10E manufactured by JL Industries.
 - 2. Stored Pressure Operated: Deep Drawn.
 - 3. Class: A:B:C type.
 - 4. Size: 10 pound (4.54 kg).
 - 5. Finish: Baked polyester powder coat, color to be selected by Architect.
 - 6. Temperature range: Minus 65 degrees F (Minus 54 degrees C) to 120 degrees F (49 degrees C).
- D. Carbon Dioxide Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
 - 1. Basis of Design: Sentinel 10 manufactured by JL Industries.
 - 2. Class: B:C type.
 - 3. Size: 10 pound (4.54 kg).
 - 4. Finish: Baked enamel, color to be selected by Architect.
 - 5. Temperature range: Minus 40 degrees F (Minus 40 degrees C) to 120 degrees F (49 degrees C).

2.3 FIRE EXTINGUISHER CABINETS

- A. Existing fire extinguisher cabinet for reuse:
 - 1. Verify fire extinguisher cabinet is in good working order prior to installation. If not, notify Owner.
- B. General:
 - 1. Basis of Design:
 - a. Ambassador 1017G10 manufactured by JL Industries.
 - 2. Size to accommodate indicated extinguisher and accessories.
 - 3. Doors:
 - a. Door Glazing: Float glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.
 - 4. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
 - 5. Fabrication: Weld, fill, and grind components smooth.
 - 6. Finish of Cabinet Exterior Trim and Door: Baked enamel, color to be selected by Architect.

- 7. Finish of Cabinet Interior: White enamel.
- C. Standard Cabinet Construction:
 - 1. Non-fire-resistance-rated.
 - 2. Formed primed steel sheet; 0.036 inch (0.9 mm) thick base metal.
- D. Cabinet Configuration: Fully-Recessed.
- E. Cabinet Configuration: Partially-Recessed.
 - 1. Trim: Flat square edge, with ____ inch (____ mm) wide face.

2.4 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Extinguisher Theft Alarm: Battery operated alarm, 10 second delay for disarming, activated by opening cabinet door.
 - 1. Location(s): Provide at each fire extinguisher cabinet
- C. Cabinet Signage:
 - 1. Lettering: "FIRE EXTINGUISHER" decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).
- D. Floor Signs:
 - 1. Floor Sign: 17-1/2 inch (445 mm) diameter vinyl sign with "DO NOT BLOCK FIRE EXTINGUISHER", directional arrow, and fire extinguisher icon.
 - 2. Manufacturers:
 - a. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - b. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. Locate as indicated on Drawings, as directed by the Owner, and as follows:
 - 1. Provide one Multipurpose Fire Extinguisher with wall bracket in each of the following locations:
 - a. Mechanical Rooms.
 - b. Electrical Rooms.
 - c. MDF/IDF/Telecommunications Rooms.
 - d. Fire Riser Rooms.
 - e. Auditoriums of 4000 square feet or less.
- B. Install in accordance with manufacturer's instructions.
- C. Install cabinets plumb and level in wall openings, such that it complies with accessibility requirements.
- D. Secure rigidly in place.
- E. Place extinguishers in cabinets.
- F. Position cabinet signage where indicated.

3.3 MAINTENANCE

- A. Refer to Section 01 77 00 - Closeout Procedures for additional requirements relating to maintenance service.

- B. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION

SECTION 10 51 13 - METAL LOCKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal lockers.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete base construction.
- B. Section 06 10 00 - Rough Carpentry: Wood base construction.
- C. Section 06 10 00 - Rough Carpentry: Wood blocking and nailers.
- D. Section 06 20 00 - Finish Carpentry: Bench tops for locker bench support brackets.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2022.
- E. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023.
- F. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).
- G. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.
 - 1. Wired Access Control: Include power requirements and standard wiring diagrams for specified products.
- C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
 - 1. Wired Access Control: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
- D. Full Size Sample: One full-size locker of each construction specified for evaluation of construction.
- E. Samples: Submit two samples ___ by ___ inches (___ by ___ mm) in size showing color and finish of metal locker material.
- F. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are acceptable for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.

B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 LOCKER APPLICATIONS

- A. Student Lockers: Metal lockers, recessed mounted.
1. Basis of Design: _____ manufactured by _____.
 2. Width: 9 inches (229 mm).
 3. Depth: 12 inches (305 mm).
 4. Height: 72 inches (1830 mm).
 5. Configuration: Single tier.
 6. Fittings: Size and configuration as indicated on drawings.
 - a. Hat shelf.
 - b. Single shoe shelf.
 - c. Coat rod.
 - d. Hooks: One single prong.
 7. Ventilation: Louvers at top and bottom of door panel.
 8. Locking: Padlock hasps, for padlocks provided by Owner.
 - a. Locking Action: Positive, automatic type, whereby locker may be locked when open, then closed without unlocking.
 9. Provide sloped top.
 10. Color: As selected from manufacturer's full range by Architect.

2.3 METAL LOCKERS

- A. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.
- B. Locker Case Construction:
1. Heavy-Duty, Welded Construction: Made of formed and welded together sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
 - a. Assembly: Do not use bolts, screws, or rivets to assemble locker bodies.
 - b. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
 - 1) Unperforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
 - (a) Uncoated.
 - (b) Zinc-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation G60/Z180.
 - (c) Zinc-Iron-Alloy-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation A40/ZF120.
 - (d) Zinc-Coated by the Electrolytic Process: Comply with ASTM A879/A879M, coating designation 30Z.
 - (e) Perforations: Manufacturer's standard pattern of square holes.
 - 2) Expanded Steel Sheet: Made from ASTM A1008/A1008M carbon steel sheet and complying with ASTM F1267, Type II, expanded and flattened, style 3/4 - 16, with a minimum 70 percent open area.
 - (a) Class 1, uncoated.
 - (b) Class 2, hot-dip zinc-coated, galvanized or galvanized.
 - 3) Body and Shelves: 16 gauge, 0.0598 inch (1.52 mm).
 - 4) Backs: 18 gauge, 0.0478 inch (1.21 mm).
 - 5) Base: 18 gauge, 0.0478 inch (1.21 mm).
 - (a) Height: 4 inches (100 mm).
 - 6) Legs: Manufacturer's standard
 - (a) Form by extending frame members.

- (b) Fabricate from 14 gauge, 0.0747 inch (1.90 mm) nominal thickness steel sheet specified above, welded to bottom of locker.
 - (c) Height: 6 inches (152 mm).
 - c. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
 - 1) Door Frame: 16 gauge, 0.0598 inch (1.52 mm), minimum.
 - d. Where ends or sides are exposed, provide flush panel closures.
 - e. Provide filler strips where indicated or required, securely attached to lockers.
 - 2. Standard-Duty, Knocked Down Construction: Made of formed sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
 - a. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
 - 1) Unperforated Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
 - (a) Uncoated.
 - (b) Zinc-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation G60/Z180.
 - (c) Zinc-Iron-Alloy-Coated by the Hot-Dip Process: Comply with ASTM A653/A653M, coating designation A40/ZF120.
 - (d) Zinc-Coated by the Electrolytic Process: Comply with ASTM A879/A879M, coating designation 30Z.
 - (e) Perforations: Manufacturer's standard pattern of square holes.
 - 2) Expanded Steel Sheet: Made from ASTM A1008/A1008M carbon steel sheet and complying with ASTM F1267, Type II, expanded and flattened, style 3/4 - 16, with a minimum 70 percent open area.
 - (a) Class 1, uncoated.
 - (b) Class 2, hot-dip zinc-coated, galvanized or galvanized.
 - 3) Body and Shelves: 24 gauge, 0.0239 inch (0.61 mm).
 - 4) Backs: 24 gauge, 0.0239 inch (0.61 mm).
 - 5) Base: 18 gauge, 0.0478 inch (1.21 mm).
 - (a) Height: 4 inch (100 mm).
 - 6) Legs: Manufacturer's standard.
 - (a) Form by extending frame members.
 - (b) Fabricate from 14 gauge, 0.0747 inch (1.90 mm) nominal thickness steel sheet specified above, welded to bottom of locker.
 - (c) Height: 6 inches (152 mm).
 - b. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
 - 1) Door Frame: 16 gauge, 0.0598 inch (1.52 mm), minimum.
 - c. Where ends or sides are exposed, provide flush panel closures.
 - d. Provide filler strips where indicated, securely attached to lockers.
- C. Drawer Base with Bench:
 - 1. Top, Bottom, Sides, Back, and Drawer: 16 gauge, 0.0598 inch (1.52 mm) sheet steel.
 - 2. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.
 - 3. Integral self latching mechanism triggered by operation of wardrobe door.
 - 4. Bench: Mixed hardwood.
- D. Latches and Door Handles: Manufacturer's standard.
 - 1. Latching Components: 300 Series Stainless Steel (ASTM A240/A240M).
 - 2. Latching: Manufacturer's standard for locking arrangement selected.
 - a. Three-Point Lift Handle Gravity Latch: Pocket-mounted, provide for doors 18 inches (457 mm) or taller.

- 1) Handle Pocket, Recess: Stainless steel flush-mounted cup recessed into face of door.
- 2) Handle: Steel finger lift mechanism with exposed portion encased in molded plastic trigger.
 - (a) Padlock Eye: Integral with lift trigger, sized for use with 9/32 inch (7.1 mm) diameter padlock shackles.
- 3) Latching Mechanism: Spring activated nylon slide latch enclosed in steel latch channel allows closing of door while padlock or built-in lock is in position.
- 4) Lock Hole Filler Plate: Manufacturer's standard. Provide for lockers intended to be unsecured or secured with padlocks.
- 5) Rubber bumpers riveted to door stops for silent operation.
- b. Three-Point Pull Handle Gravity Latch: Surface-mounted, provide for doors 18 inches (457 mm) or taller.
 - 1) Handle: Steel finger lift mechanism.
 - 2) Latching Mechanism: Spring activated nylon slide latch enclosed in steel latch channel allows closing of door while padlock or built-in lock is in position.
 - 3) Padlock Eye: Integral with lift handle, sized for use with 9/32 inch (7.1 mm) diameter padlock shackles.
 - 4) Lock Hole Filler Plate: Manufacturer's standard. Provide for lockers intended to be unsecured or secured with padlocks.
 - 5) Rubber bumpers riveted to door stops for silent operation.
- c. Three-Point/Three-Sided Cremone Latch.
 - 1) Latching mechanism operated by a steel handle welded to a three-point Cremone-type assembly.
 - 2) Latching rods, 3/8 inch (9.5 mm) diameter, engage top and bottom edge of locker frame. 3/16 inch (4.8 mm) thick center latch engages door jamb.
- d. Single-Point Latch: Provide for doors indicated.
 - 1) Stationary latch welded securely to locker frame.
 - 2) Latch extends no more than 1-1/4 inch (31.8 mm) into locker opening, penetrating through cup.
 - 3) Flush-mounted, recessed stainless steel cup in a formed door with 18 gauge, 0.0478 inch (1.21 mm) vertical back panel stiffener.
- e. Spring Latch: Provide for box-size lockers and where indicated.
 - 1) 16 gauge, 0.0598 inch (1.52 mm) cold rolled steel, zinc plated with a 10 gauge, 0.1345 inch (3.42 mm) latch and 16 gauge, 0.0598 inch (1.52 mm) stainless steel lock hasp and completely enclosed stainless steel spring.
 - 2) Assembled using six nickel-plated rivets.
 - 3) Equip box locker doors with a padlock hasp and a stainless steel strike plate with an integral handle pull. Box locker doors may also be equipped with built-in locks.
- f. Access Control Single-Point Latch: Provide for doors indicated.
 - 1) Wireless integrated access control locking devices.
 - 2) Stationary latch welded securely to locker frame.
 - 3) Rubber bumpers riveted to door stops for silent operation.
- E. Cup, Pocket: Manufacturer's standard, with integral pull, and recessed surface punched for installation of lock, latch lift mechanism, and number plate.
- F. Hinges: Continuous piano hinge with powder coat finish to match locker color.
- G. Hinges: Heavy-duty, 7-knuckle type; two for doors under 42 inches (1050 mm) high; three for doors over 42 inches (1 050 mm) high.
- H. Sloped Top: 20 gauge, 0.0359 inch (0.91 mm), with closed ends.
- I. Trim: 20 gauge, 0.0359 inch (0.91 mm).

- J. Coat Hooks: Stainless steel or zinc-plated steel.
- K. Number Plates: Provide oval shaped aluminum plates. Form numbers ____ inch (____ mm) high of block font style with ADA designation, in contrasting color.
- L. Locks: Locker manufacturer's standard type indicated in Applications article above.
- M. RFID Lock System Components and Accessories: Manufacturer's standard.
 - 1. Graphic user interface for central configuration, monitoring and management of locker system.
 - 2. Locker management software with ability to generate audit trail: Logging all actions on the lock including date, time, lock status, RFID media type, and serial number in a centralized SQL database.
 - 3. Programmable networked RFID locking device
 - 4. Contactless RFID Media: Cards, wristbands, key fobs, and other NFC connected devices.
 - 5. Power: Battery operated.
 - 6. Connectivity: Wired.
- N. Locker Groups: Gang lockers in groups of two and assemble in factory for shipment as a single unit.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.
- B. Verify bases and embedded anchors are properly sized.
- C. Verify that power and ethernet are installed and enabled. See manufacturer drawings for recommended outlet or junction box placement.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds (445 N).
- E. Bolt adjoining locker units together to provide rigid installation.
- F. Install end panels, filler panels, and sloped tops.
- G. Install fittings if not factory installed.
- H. Replace components that do not operate smoothly.

3.3 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION

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SECTION 10 56 13 - METAL STORAGE SHELVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Four post shelving.
- B. Cantilevered shelving.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and reinforcement in walls for anchoring shelving units.
- B. Section 09 21 16 - Gypsum Board Assemblies: Blocking and reinforcement in walls for anchoring shelving units.
- C. Section 10 56 26 - Mobile Storage Shelving: Installation of metal storage shelving on mobile carriages.

1.3 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Rated uniform shelf loads.
 - 2. Details of shelving assemblies, including reinforcement.
 - 3. Accessories.
 - 4. Substrate preparation instructions and recommendations.
 - 5. Storage and handling requirements and recommendations.
 - 6. Installation methods.
 - 7. Specimen warranty.
 - 8. Maintenance methods.
- C. Test Reports: Provide independent agency test reports documenting compliance with specified structural requirements.
 - 1. In lieu of test reports, detailed drawings stamped and sealed by a Professional Engineer, licensed in the state of Texas, will be acceptable.
- D. Shop Drawings: Indicate location, type, and layout of shelving, including lengths, heights, and aisle layout, and relationship to adjacent construction.
 - 1. Indicate methods of achieving specified anchoring requirements.
- E. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and finishes.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 77 00 - Closeout Procedures, for additional provisions.
 - 2. Extra Shelves: Two of each size with shelf brackets.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of documented experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspect for dents, scratches, or other damage. Replace damaged units.
- B. Store in manufacturer's unopened packaging until ready for installation.
- C. Store under cover and elevated above grade.

1.7 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Provide one year manufacturer warranty covering defects of manufacturing and workmanship and rust and corrosion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Four Post Shelving:
 - a. ASI Storage Solutions: www.asi-storage.com.
 - b. Hallowell: www.hallowell-list.com.
 - c. List Industries, Inc: www.listindustries.com/#sle.
 - d. Montel: www.montel.com/#sle.
 - e. Penco Products, Inc: www.pencoproducts.com/#sle.
 - f. SpaceSaver Corporation: www.spacesaver.com/#sle.
 - g. Tennsco Storage: www.tennsco.com/#sle.
 - 2. Cantilevered Shelving:
 - a. Montel: www.montel.com/#sle.
 - b. SpaceSaver Corporation: www.spacesaver.com/#sle.
 - c. Tennsco Storage: www.tennsco.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 SHELVING - GENERAL

- A. Refer to Drawings for layout and sizes.
- B. Anchors: Provide anchoring hardware to secure each shelving unit to floor and wall.
 - 1. Provide hardware of type recommended by manufacturer for substrate.
 - 2. Refer to Drawings for additional details of anchorage.

2.3 FOUR POST SHELVING

- A. Four Post Shelving: Steel post-and-beam type with sway bracing, shelving brackets, shelving surfaces, and accessories as specified.
 - 1. Basis-of-Design:
 - a. Metal Shelving, Standalone, Heavy Duty, 5510-18 manufactured by Hallowell.
 - 2. Unit Width: 48 inches (1219 mm), center to center of posts.
 - 3. Shelf Material: Sheet metal, no lip.
 - 4. Shelf Capacity: 800 lbs, minimum.
 - 5. Shelf Beam Capacity: 800 lbs. per shelving bay.
 - 6. Shelf Deflection: L/140, maximum, under specified uniform load.
 - 7. Adjustability of Shelving: At intervals of 1 inches (25 mm) on center, minimum.
 - 8. Shelf Depth: 18 inches, minimum.
 - 9. Shelves per Unit: 5.
 - 10. Unit Height: 87 inches.
 - 11. Finish: Baked enamel, medium gloss.

- a. Color: Manufacturer's standard gray.
 12. Provide single-face and double-face units where indicated.
 13. Number of Units: As indicated on Drawings.
- B. Posts: Formed sheet members; perforations exposed on face of members are not acceptable.
1. Metal Thickness: 13 gauge, 0.0897 inch (2.28 mm).
 2. Post Shape: Tee intermediate posts, angle end posts forming corners.
 3. Post Face Width: 2 inches (51 mm), maximum.
 4. Connecting Hardware: Manufacturer's standard.
 5. Post Bases: Flat steel foot plate.
- C. Bracing: Formed sheet members.
1. Back Sway Bracing: _____; at back of each unit.
 2. Side Sway Bracing: _____; at each side of each unit.
 3. Refer to Drawings for additional details of bracing.

2.4 CANTILEVERED SHELVING

- A. Cantilevered Shelving: Freestanding formed steel post frame with slots for cantilevered shelving brackets, shelving brackets, shelving surfaces, and accessories as specified.
1. Unit Width: __ inches (__ mm), center to center of posts.
 2. Shelf Capacity: Uniform distributed load of __ psf (__ kPa), minimum.
 3. Shelf Deflection: L/140, maximum, under specified uniform load.
 4. Adjustability of Shelving: At intervals of __ inches (__ mm) on center, minimum.
 5. Shelf Depth: __ inches (__ mm), minimum.
 6. Unit Depth: Not more than __ inch (__ mm) greater than shelf depth.
 7. Clear Shelf Opening Height: __ inches (__ mm), minimum.
 8. Shelves per Unit: As indicated on drawings.
 9. Unit Height: __ inches (__ mm), overall , maximum.
 10. Finish: _____.
 11. Provide single-face and double-face units where indicated.
 12. Number of Units: As indicated on Drawings.
- B. Frame: Formed steel members comprising posts, horizontal spreaders at top and bottom, and base brackets resisting overturning; frame configuration providing full face height and width available for adjustable shelves.
1. Sheet Metal Thickness: __ gauge, __ inch (__ mm), minimum.
 2. Base Brackets Height from Floor: __ inches (__ mm), maximum.
 3. Connecting Hardware: _____.
 4. Provide manufacturer's standard adjustable leveling devices.
- C. Shelf Brackets: Combination shelf support and bookend, formed steel; full depth of shelves and minimum __ inches (__ mm) height above shelf surface; rounded outer edges and corners for safety.
1. Thickness: __ gauge, __ inch (__ mm), minimum.
 2. Profile: Sloped _____ degrees from back to front.
 3. Connection to Posts: _____.
- D. Shelves: Formed steel, finished on all surfaces.
1. Thickness: __ gauge, __ inch (__ mm), minimum.
 2. Bottom Shelf Edge Profile: __ inch (__ mm) with integral kickplate.
 3. Upper Shelves Edge Profile: Extending __ inch (__ mm), maximum, below top surface of shelf.
 4. Provide raised edge lip on _____; height __ inches (__ mm).
 5. Shelf Connections: _____.
 6. Provide canopy tops of same construction as adjustable shelves.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate is level and that clearances are as specified.
- B. Verify that walls are suitable for shelving attachment.
- C. Do not begin installation until substrates have been properly prepared.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Anchor and reinforce as specified, as indicated on drawings, and as recommended by manufacturer.
- C. Install shelving with shelf surfaces level and vertical supports plumb; adjust feet and bases as required.
- D. Out-Of-Square Tolerance - Four Post Shelving: Maximum of 1/8 inch (3 mm) difference in distance between bottom shelf and canopy top, measured along any post in any direction.

3.4 CLEANING

- A. Clean shelving and surrounding area after installation.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 10 56 17 - WALL-MOUNTED STANDARDS AND SHELVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Steel shelf standards, brackets, and accessories.
- B. Aluminum shelf standards, brackets, and accessories.
- C. Steel shelf support brackets.
- D. Closet rods for mounting on brackets.
- E. Shelves.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood blocking in walls for attachment of standards.
- B. Section 06 20 00 - Finish Carpentry: Wood shelves.
- C. Section 09 21 16 - Gypsum Board Assemblies: Blocking in metal stud walls for attachment of standards.

1.3 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.4 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Section 01 77 00 - Closeout Procedures for additional provisions.
 - 2. Extra Brackets: Ten of each size of standard straight bracket.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products under cover and elevated above grade.
- B. Store products in manufacturer's unopened packaging until ready for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
1. Steel Shelf Standards and Brackets:
 - a. Knappe & Vogt Manufacturing Company; 87™/187™ Series: www.knappeandvogt.com/#sle.
 2. Aluminum Shelf Standards, Brackets, and Accessories:
 - a. Rakks/Rangine Corporation: www.rakks.com/#sle.
 3. Steel Shelf Support Brackets:
 - a. Centerline Brackets; Floating Wall Mount: www.countertopbracket.com/#sle.
 4. Shelving:
 - a. Rakks/Rangine Corporation; Aluminum Shelving: www.rakks.com/#sle.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 COMPONENTS

- A. Steel Shelf Standards, Brackets, and Accessories:
1. Super-Duty Shelf Standards and Brackets: Single-slotted channel standards for brackets adjustable in 1 inch (25 mm) increments along entire length of standard, drilled and countersunk for screws.
 - a. Basis of Design Product: _____.
 - b. Load Capacity: Recommended by manufacturer for loading of _____ pounds (_____ kg) per pair of standards.
 - c. Face Width: 5/8 inch (16 mm), single slotted.
 - d. Material: 12 gauge, 0.1046 inch (2.66 mm) sheet steel.
 - e. Lengths: _____ inches (_____ mm).
 - f. Finish: _____.
 - g. Brackets: 12 gauge, 0.1046 inch (2.66 mm) sheet steel, reinforced, locking into slots with molded nylon cam lock lever; size to suit shelves; same finish as standards.
 - h. Application: Use extra heavy duty standards at _____.
 - i. Bracket Quantity: Provide one bracket for each _____ inches (_____ mm) of standard length.
 2. Extra-Duty Shelf Standards and Brackets: Double-slotted channel standards for brackets adjustable in 1 inch (25 mm) increments along entire length of standard, drilled and countersunk for screws.
 - a. Basis of Design Product: _____.
 - b. Load Capacity: Recommended by manufacturer for loading of _____ pounds (_____ kg) per pair of standards.
 - c. Material: Steel.
 - d. Lengths: _____ inches (_____ mm).
 - e. Finish: _____.
 - f. Brackets: Double tab type, locking into slots; size to suit shelves; same finish as standards.
 - g. Application: Use heavy duty standards at _____.
 - h. Bracket Quantity: Provide one bracket for each _____ inches (_____ mm) of standard length.
 3. Heavy-Duty Shelf Standards and Brackets: Double-slotted channel standards for brackets adjustable in 1 inch (25 mm) increments along entire length of standard, drilled and countersunk for screws.
 - a. Basis of Design Product: _____.

- b. Load Capacity: Recommended by manufacturer for loading of ____ pounds (____ kg) per pair of standards.
 - c. Lengths: ____ inches (____ mm).
 - d. Finish: Powder-coated.
 - e. Brackets: Double tab type, locking into slots; size to suit shelves; same finish as standards.
 - f. Provide snap-in cover strips to hide unused slots and screw holes.
 - g. Application: Use decorative heavy duty standards at _____.
 - h. Bracket Quantity: Provide one bracket for each ____ inches (____ mm) of standard length.
4. Heavy-Duty Shelf Standards and Brackets: Single-slotted channel standards for brackets adjustable in 1 inch (25 mm) increments along entire length of standard, drilled and countersunk for screws.
 - a. Basis of Design Product: KV 83/183.
 - b. Load Capacity: Recommended by manufacturer for loading of 300 to 450 pounds (135 to 200 kg) per pair of standards.
 - c. Lengths: As indicated on drawings.
 - d. Finish: Chrome.
 - e. Brackets: Double tab type, locking into slots; size to suit shelves; same finish as standards.
 - f. Provide snap-in cover strips to hide unused slots and screw holes.
 - g. Application: Use decorative heavy duty standards at _____.
 - h. Bracket Quantity: Provide one bracket for each ____ inches (____ mm) of standard length.
5. Regular-Duty Shelf Standards and Brackets: Single-slotted channel standards for brackets adjustable in 1 inch (25 mm) increments along entire length of standard, drilled and countersunk for screws.
 - a. Basis of Design Product: KV 80/180.
 - b. Load Capacity: Recommended by manufacturer for loading of ____ pounds (____ kg) per pair of standards.
 - c. Face Width: 5/8 inch (16 mm).
 - d. Face Width: 5/16 inch (8 mm).
 - e. Material: 16 gauge, 0.0598 inch (1.52 mm) sheet steel.
 - f. Lengths: ____ inches (____ mm).
 - g. Finish: _____.
 - h. Brackets: 16 gauge, 0.0598 inch (1.52 mm) sheet steel, reinforced, locking into slots; size to suit shelves; same finish as standards unless not available.
 - i. Brackets: 14 gauge, 0.0747 inch (1.90 mm) sheet steel, locking into slots; size to suit shelves; zinc coated finish.
 - j. Close top of standards with matching caps.
 - k. Application: Use standard duty standards at _____.
 - l. Bracket Quantity: Provide one bracket for each ____ inches (____ mm) of standard length.
6. Shelf Standard Accessories:
 - a. At shelves indicated as sloping provide adjustable slant brackets.
 - b. Where cornices are indicated as part of shelving provide cornice brackets.
 - c. Where shelves are indicated to be fastened to brackets provide brackets with flanges for screwing into end of shelf, steel shelf rests, or flanged brackets; fasten with screws.
 - d. Provide other accessories as indicated.
7. Closet Rods: Steel tubing for wall mounting in flange fittings.

- a. Type: Round chrome look, extra heavy duty; 1-5/16 inch (33 mm) outside diameter, 0.109 inch (2.77 mm) wall thickness.
 - b. Length: As required for application, up to 12 feet (3655 mm).
 - c. Provide mounting fittings to suit application.
- B. Aluminum Shelf Standards, Brackets, and Accessories:
1. Aluminum Components: ASTM B221 (ASTM B221M), alloy 6063, temper as indicated, with anodized finish complying with to AAMA 611, or powder coating complying with AAMA 2603 or AAMA 2604 for select colors.
 2. Wall-Mounted Shelf Standards: Channel type extruded aluminum standards mounted on walls and designed to hold shelf support brackets inserted into channel ends or access slots and slid to desired position.
 - a. Material: Extruded aluminum, ASTM B221 6063-T6 alloy and temper.
 - b. Lengths: As indicated on drawings.
 - c. Finish: To be selected by Architect from manufacturer's full line.
 - d. Manufacturer/Profile No: .
 - e. Mounting: _____.
 - f. Accessories: Provide access slots and channel covers.
 3. Pole Support Standards: Extruded aluminum pole supports with two or more channels designed to hold shelf support brackets inserted into channel ends or access slots and slid into desired position.
 - a. Material: Extruded aluminum, ASTM B221 6063-T6 alloy and temper.
 - b. Lengths: _____ inches (_____ mm).
 - c. Finish: As selected by Architect from manufacturer's full line.
 - d. Mounting: _____.
 - e. Accessories: Provide spline connectors.
 4. Shelf Support Brackets:
 - a. Bracket Type: Rectangular bracket.
 - b. Material: Extruded aluminum, ASTM B221 6063-T6 alloy and temper.
 - c. Lengths: _____ inches (_____ mm).
 - d. Finish: As selected by Architect from manufacturer's full line.
 - e. Accessories: Provide universal bookends, shelf stiffeners, desk brackets, L-brackets, shelf rests, retaining pins, glass hold downs, and hang bars.
- C. Steel Shelf Support Brackets:
1. Material: Steel, ASTM A36/A36M.
 2. Bracket Type: _____, with predrilled mounting holes on vertical leg for attachment to wood stud or blocking.
 3. Bracket Horizontal Support Length: _____ inches (_____ mm).
 4. Bracket Thickness: _____ inches (_____ mm).
 5. Finish: As selected by Architect from manufacturer's full line.
 6. Bracket Quantity: Provide a bracket _____ inches (_____ mm) from each end and one support bracket for each _____ inches (_____ mm) of shelf length between end brackets.
- D. Shelves:
1. Aluminum Shelves: Extruded aluminum sections with textured flat top and bottom ribs; ASTM B221 6063-T5 alloy and temper; finished on all surfaces.
 - a. Shelf Capacity: Uniform distributed load of ___ psf (___ kPa), minimum.
 - b. Shelf Deflection: ___ inch (___ mm) in ___ inches (___ mm), maximum, under specified uniform load.
 - c. Shelf Thickness: _____ inch (_____ mm).
 - d. Shelf Length: _____ inches (_____ mm).
 - e. Shelf Depth: ___ inches (___ mm).
 - f. Finish: As selected by Architect from manufacturer's full line.

- g. Accessories: Provide shelf lip brackets, shelf hold-down clips, shelf splines, label holders, shelf end caps, sliding book ends, and shelf bridge clips.
- 2. Laminate Faced Shelves: Particleboard or medium density fiberboard covered with high pressure decorative laminate on both sides.
 - a. Edge Finish: Matching laminate, all four edges.
 - b. Substrate Thickness: 3/4 inch (19 mm), nominal.
 - c. Length: 48 inches (1219 mm).
 - d. Laminate: NEMA LD 3 Type HGL.
 - e. Laminate Color and Pattern: To be selected by Architect from manufacturer's full line.
 - f. Shelf Quantity: Provide one shelf for each ____ inches (____ mm) of length of standard, per pair of standards, unless otherwise indicated.
- E. Fasteners: Screws as recommended by manufacturer for intended application or as otherwise required by project conditions. Finish of exposed to view fasteners to match finish of standards and other components.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount standards or brackets to solid backing capable of supporting intended loads.
- C. Install brackets, shelving, and accessories.
- D. Provide double sided foam tape between adjoining sections of aluminum shelving to maintain alignment.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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SECTION 11 57 00 - VOCATIONAL AND SHOP EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Workbenches..
- B. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry: Blocking.

1.2 REFERENCE STANDARDS

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASME BPVC - Boiler and Pressure Vessel Code; 2023.
- C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- F. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2022.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023.
- H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- I. {RSTEMP#623}
- J. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of laboratory equipment with laboratory casework and Owner-furnished, Owner-installed laboratory equipment.
- B. Preinstallation Meeting: Convene one week before starting work of this section.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.4 SUBMITTALS

- A. Refer to Section 01 40 00 - Quality Requirements for submittal procedures.
- B. Product Data: Provide equipment dimensions and construction; equipment capacities; physical dimensions; utility and service requirements, clearances, and locations; required accessories and optional features; and point loads.
- C. Shop Drawings: Indicate equipment locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances, and installation and servicing clearances required.
- D. Samples: Submit two samples of exposed finish surfaces, a minimum of 6 by 6 inches (150 by 150 mm) in size illustrating color and finish.

- E. Operation Data: Include description of equipment operation and required adjusting and testing .
- F. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the types of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience and approved by manufacturer.
- C. Preconstruction Testing: Factory-test each type of equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package each piece of equipment to ensure protection from damage during shipment and delivery. Legibly indicate on the exterior of each container or crate, the shipping address and a brief description of its contents. Outside of the container, fasten a waterproof envelope containing a packing list and complete instructions for uncrating and setting the equipment in place.
- B. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.7 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty for materials, parts, and labor for sterilizer chamber.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specification requirements, products by the listed manufacturers or fabricators may be submitted for use in the Work
 - 1. fischer scientific, Part of Thermo Fisher Scientific: www.fischersci.com.
 - 2. Labconco Corporation: www.labconco.com.
 - 3. Paasche Airbrush Company: www.paascheairbrush.com.
 - 4. Uline: www.uline.com.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.
 - 1. Manufacturers and fabricators not listed must have a minimum of 5 years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered. Submit as a substitution

2.2 EQUIPMENT

- A. General Conditions:
 - 1. Prewire and prepipe each unit of equipment complete with trim and fittings. Include reduced pressure or atmospheric type backflow preventer fitting to prevent backflow of polluted water or waste into water supply system or equipment. Comply with applicable code requirements.
 - 2. Securely affix a plate which includes the manufacturer's name, address, and catalog or serial number to each equipment item. If applicable, include pressure vessels bearing the ASME stamp and pressure rating, indicating compliance with applicable code requirements.

3. Installation Accessories: Provide all rough-in frames, anchors, supports, accessories and closure trim required for complete installation.
 4. Use corrosion-resistant materials for all rivets, bolts, nuts, studs, spacers, and welding metal.
 5. Fully assemble equipment in factory, except for those items which cannot be moved to their final locations as single item.
- B. Painting Equipment:
1. Bench Booths:
 - a. Basis of Design:
 - 1) Model EBF-5-T1 Bench Booth with Fan and Motor manufactured by Paasche Airbrush Company.
 - b. Overall Size:
 - 1) Width: 64 inches (1626 mm).
 - 2) Depth: 38 inches (965 mm).
 - 3) Height: 68 inches (1727 mm).
 - c. Fan:
 - 1) Capacity: 1500 cfm (2549 cmh).
 - 2) Power: 1 Ph., 115/230 V.
 - d. Accessories:
 - 1) Belt Guards.
 - 2) Draft Gauge.
 - 3) Filters.

2.3 MATERIALS

- A. Aluminum Sheet: ASTM B209/B209M, 5005-H32 minimum; alloy and temper recommended by aluminum producer and finisher for use and finish indicated.
 1. Finish: AAMA 2603.
- B. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating.
- C. Steel Sheet: ASTM A1008/A1008M uncoated, cold rolled, Type CS (commercial steel), exposed, ASTM A1008/A1008M uncoated, cold rolled, Type CS (commercial steel), exposed, ASTM A879/A879M electrolytic zinc coating over ASTM A1008/A1008M steel sheet substrate, or ASTM A879/A879M electrolytic zinc coating over ASTM A1008/A1008M steel sheet substrate.
- D. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304 and 316, stretcher-leveled standard of flatness.
- E. Laminated Safety Glass: {RS#623}.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Fasteners: Stainless-steel, or other corrosion-resistant materials, standard with the manufacturer.
- H. Welding Materials: Comply with ASME BPVC SEC II-C.
- I. Metal Finishes: Comply with NAAMM AMP 500-06.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that utility connections, rough-in frames, anchors and supports are accurately placed and deliver building services at specified characteristics and/or within acceptable functional ranges.
- B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with standards required by authority having jurisdiction.
- C. Large Components: Ensure that large components can be moved into final position without damage to other construction.
- D. Mounting: Anchor equipment securely in place.
 - 1. Mount equipment in compliance with SMACNA (SRM) requirements.
- E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner, and their locations are coordinated with equipment rough-in requirements.
 - 1. Require manufacturer's installer to supervise connection to utilities being performed by mechanical and electrical trades.
 - 2. Make connections between ferrous and nonferrous metallic pipe with dielectric waterways and flanges having temperature and pressure rating equal to or greater than that specified for the connecting piping. Use dielectric waterways internally lined with an insulator specifically designed to prevent current flow between dissimilar metals.
 - 3. Connect steam lines on equipment to building source only after building steam lines have been cleaned of preservatives and materials that may be harmful to the equipment.
- F. Touch-up minor damaged surfaces caused during installation. Replace damaged components as directed by Architect.

3.3 FIELD QUALITY CONTROL

- A. Refer to Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform functional testing in accordance with referenced specification requirements. Test one item or similar model, as necessary or appropriate, to ensure that it is operational and installation complies with specification requirements.

3.4 ADJUSTING

- A. Adjust operating equipment to efficient operation.

3.5 CLOSEOUT ACTIVITIES

- A. Refer to Section 01 77 00 - Closeout Procedures for closeout submittals.
- B. Refer to Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Final Acceptance: Remove labels, fingerprints, and clean all surfaces both inside and out. Repair any marred or damaged surfaces that affect appearance, such as both interior and exterior of cabinets in a manner acceptable to Owner. Replace any parts that cannot be repaired in such a manner.

END OF SECTION

SECTION 11 61 23 - TENSION WIRE GRID SYSTEM

PART 1 - GENERAL

1.1 SECTION SUMMARY

- A. This specification describes the provision of the theatrical tension wire grid system above the St. Phillip's Watson Fine Arts Center Black Box addition.
- B. Related Documents
 - 1. Theatre Rigging Drawings ("TR" Series) and general provisions of the contract including general and supplementary conditions and Division 1 Specification sections apply to this section.

1.2 SECTION INCLUDES

- A. Coordination, provision, installation, inspection, commissioning, testing, documentation, instruction and warranties of a Tension Wire Grid System.
- B. Plant, materials, equipment, transport and labor necessary to accomplish this and have a complete and proper System.
- C. Also includes:
 - 1. Required licenses and permits including payment of charges and fees.
 - 2. All fees for testing, documenting, and notary public services.
 - 3. Verification of dimensions and conditions at the job site.
 - 4. Provision of required pre-installation submittals and project record manuals.
 - 5. Installation in accordance with the contract document, manufacturer's recommendation, and in conformity with applicable codes and authority having jurisdiction.
 - 6. Extension of electrical service, including ground, to equipment locations.

1.3 RELATED WORK

- A. Division 05: Structural
- B. Section 11 61 33: Theatrical Rigging Systems.
- C. Section 11 61 62: Theatrical Lighting and Controls.
- D. Section 11 61 43: Stage Draperies

1.4 REFERENCES

- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
 - 1. American Iron and Steel Institute (AISI),
 - 2. American National Safety Institute (ANSI),
 - 3. American Society of Mechanical Engineers (ASME),
 - 4. American Society of Testing and Materials (ASTM),
 - 5. National Electrical Manufacturer's Association (NEMA),
 - 6. Occupational Safety and Health Administration (OHSA),
 - 7. Underwriters Laboratories (UL),

8. Entertainment Technician Certification Program (ETCP)

1.5 DESCRIPTIONS AND REQUIREMENTS

- A. The intent of the specification is to provide a complete system of theatrical stage equipment as specified and enumerated herein including delivery and installation.
 1. The Contractor is responsible for complete engineering of the system as specified and as required for proper installation and safe operation.
 2. The system shall consist of the components and functions as specified herein, shop drawings, as-built drawings, installation, field engineering supervision for check out of installation, operation/maintenance manuals and on site operation instructions to local personnel. The system shall be a complete functioning apparatus consistent with the current state of the art of entertainment industry practice and including all components necessary for the operational functions specified, whether or not each separate device is specifically mentioned. Operational functions desired are called out in terms of performance and the Contractors' proposals shall include all devices necessary to execute the operational parameters described, shown, and listed.
 3. Before expiration of the warranty period, the tension grid contractor shall visit the site to perform a maintenance check including any necessary mechanical adjustments to the tension grid.
- B. Black Box Tension-wire Grid
 1. Provide and install a tension grid manufactured from structural steel shapes and 1/8" diameter wire rope that is suspended from the overhead structure as described on the drawings.
 2. The installation of the tension grid will be closely coordinated with the other trades for placement of lighting equipment, AV equipment, architectural features, mechanical equipment, and intermediate structure.

1.6 RESPONSIBILITY AND RELATED WORK

- A. The drawings included with this specification convey general system concepts. The plans do not show complete and accurate building details. The Installer is responsible for making field measurements necessary to establish exact locations, relationships, load capacities necessary for the installation of these systems.
- B. Coordinate the work with the General, Mechanical, Electrical and other related contractors as stated in Part 1.4, and the scheduled work of other trades.
- C. Coordinate with the theatrical lighting equipment supplier the installation of the wiring devices mounted to rigging hardware.
- D. Supply accessories and minor equipment items needed for a complete system, even if not specifically mentioned in these Specifications or on the associated Drawings, without claim for additional payment.
- E. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the Tension Grid Systems Contractor to supply systems in full working order. Notify the Architect of any discrepancies in part numbers or quantities before bid. Failing to provide such notification requires Tension Grid Systems Contractor to supply items and quantities according to the intent of the Specifications and associated Drawings without claim for additional payment.
- F. Obtain all permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner including any associated charges or fees.

- G. Execute all work in accordance with all Standard Authorities listed above, and all applicable State and Local codes, ordinances, and regulations. If a conflict develops between the contract document and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

1.7 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: Design of tension grid panels, hangers, and connections to the building structure is to be completed by a Professional Engineer both experienced in the design of tension grid rigging systems and maintaining a current license in the State of Texas.
- B. Theatrical Tension Grid Systems Contractor's Qualifications: Firm experienced in the provision of systems similar in complexity to those required for this project; and meet the following:
 - 1. The primary business of contractor shall be the installation of theatrical rigging and tension grid systems.
 - 2. No less than five years of experience with equipment and systems of the specified types under the same business name.
 - 3. Experience with at least five projects involving rigging systems for facilities of this type and comparable scale within the last two years.
 - 4. Project Manager assigned to this project shall have experience on new theatrical facilities while employed with the installing contractor. Provide names of project team members with proposal.
 - 5. A competent and knowledgeable Job Superintendent will be on the job at all times when work is in progress.
 - 6. All stage rigging work must be supervised or performed by a minimum of one ETCP Certified Rigger.
 - 7. Employs only fully trained stage riggers and mechanics for the erection of the stage equipment. The stage riggers will be completely familiar with the type of equipment to be installed.
 - 8. Be a franchised dealer and service facility for the major products furnished.
 - 9. At the request of the Owner, the Contractor shall demonstrate that he has:
 - a. Adequate plant and equipment to complete the work.
 - b. Adequate staff with commensurate technical experience.
- C. Work shall be in compliance with the applicable standards listed above and all governing codes and regulations of the authorities having jurisdiction and the Contract Documents.
 - 1. Drawings and specification requirements shall govern where they exceed Code and Regulation requirements.
 - 2. Where requirements between governing Codes and Regulations vary, the more restrictive provision shall apply.
 - 3. Nothing in the Contract Documents shall be construed as authority or permission to disregard or violate legal requirements.
- D. Attend pre-installation meeting with architect before beginning the installation of systems. Attendees to this meeting must be, but not limited to the following personnel: Project Manager, Project Engineer, Field Supervisor, and Senior Field Technician.
- E. Attend project coordination meetings as called by the General Contractor, Architect and/or Architect's consultant. Attendees to these meetings must be, but not limited to the following personnel: Project Manager, Project Engineer, Field Supervisor, and Senior Field Technician.

1.8 PRE-INSTALLATION SUBMITTALS:

- A. The submittal information required by the specification is to be presented complete and as submissions noted below. Submittals are a crucial and integral part of the construction process; as such the Owner's consultant will not recommend payment to the installer above 25% of the scheduled value of this work until all submittal information has been approved. Cost for the Owner's consultant to review secondary and re-submittals due to the Installer's failure to include all required submittal information, or rejection of incomplete or improperly prepared submittal information will be the responsibility of the Installer. The cost shall be based on the hourly rates of the Architect and consultants as published in their current professional fees schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost-plus ten percent (10%).
- B. Project Submittal Part 1:
1. Provide for approval not later than thirty (30) days after issuance of Notice to Proceed and prior to commencement of Work:
 - a. Section 1: A complete schedule of submittals.
 - b. Section 2: A chronological schedule of Work in bar chart form. Revise and resubmit schedule as required to reflect construction progress.
- C. Project Submittal Part 2:
1. Provide for approval no later than sixty (60) days after issuance of notice to proceed and in accordance with previously submitted submittal schedule.
 - a. Section 1: Complete list of products to be incorporated within the Work.
 - b. Section 2: Manufacturer's data sheets for each product. Provide original manufacturer's data sheets in order as they appear in the specification. These data sheets are submitted for each product in sufficient detail to facilitate proper evaluation to the products suitability for incorporation within the Work.
 - c. Section 3: Fabric Samples. Submit a sample book of each fabric specified, containing manufacturer's standard colors available in the quality of fabric specified for the Owner's selection and approval of color. More than one color may be selected. After selection, upon request, submit one square foot sample of each fabric in each color for final review.
 - d. Section 4: Submit Material Safety Data Sheets (MSDS) for each potentially hazardous material prior to use. Include information pertaining to the hazardous material with the MSDS.
 2. Drawings:
 - a. Provide computer software generated drawings using standard industry graphic standards. Hand or poorly drawn documents will not be accepted. All drawings shall be created on a computer aided drawing (CAD) system compatible with AutoCAD release 2010. Electronic files of theatrical rigging contract documents shall not be distributed for use in generating submittal documents with the exception of architectural backgrounds.
 - b. Drawings depicting attachment of equipment to structure or mechanical assemblies that support overhead loads must show the work has been reviewed and sealed by a structural engineer licensed to practice in the State of Texas.
 - c. Installation Drawings. Provide drawings showing special details depicting methods and means specific to each product and each product manufacturer's recommended installation methods and means. Provide assembly and attachment for each product. Drawings should be reviewed and sealed by a structural engineer licensed to practice in the State of Texas.
 - d. Schematic Drawings. Provide drawings detailing inter-component and intra-component, on Theatrical Rigging Installer assembled components or fabricated products.
 - e. Conduit and Electrical Drawings. If the system incorporates an electrical or electronic system of any type, provide floor plan drawings, including all walls,

doors and rooms, showing exact power requirements and conduit routing for each system with the location of all junction boxes, terminations, etc.

- f. Equipment Drawings. Provide equipment mounting and location details including necessary physical dimensions, clearances, load limits, etc.
- g. Software diagrams showing the hierarchical structure of operator screens and functions with sample screen shots.
- h. Floor plan and Section Drawings. Provide drawings showing the exact location of all installed equipment on floor plans and/or sections such as guide wires or tracks, loft blocks, battens, etc.
- i. Custom Enclosures and Millwork Drawings. If custom enclosures or millwork is required, provide full fabrication detail drawings indicating size, material, finish and openings for equipment.
- j. Fabricated Plates, Panels, or Signage Drawings. If plates, panels, or signage is required, provide complete drawings depicting dimensioned locations of components, component types, engraving or printing information, plate material and color, and bill of material.
- k. Labeling Drawing. Provide representative equipment labeling scheme of locking rail, loading rail, etc.
- l. General Detail Drawings. Provide detail drawings depicting any unique installation methods specific to each product.
- m. Any other pertinent data generated which is necessary to provide the Work.

D. Submittal Format:

1. Electronic submission of submittals is encouraged. Where non- electronic submittals shall be bound in a three-ring D style binder sized for 150% of the material with a maximum size being a three inch spine. Use multiple volumes if necessary.
2. Provide each submittal with a unique number and be numbered in consecutive order.
3. Provide each submittal binder with a cover and a spine reflecting the project title and submittal number.
4. Provide each submittal with a complete table of contents with the following information:
 - a. Project title and number.
 - b. Submittal number. In the case of a re-submittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and be numbered in consecutive order.
 - c. Date of submission.
 - d. Referenced addendum or change-order number as applicable.
 - e. Referenced specification Section, Part, Article, Paragraph and page number or drawing reference as applicable.
 - f. Index Product Data sheets by manufacturer and model or part number.
5. Separate major grouping with labeled binder tabs.
6. Arrange product data list in alpha-numeric order when applicable followed by unspecified product arrange by manufacturer and model or part number. Follow list by manufacturer's data sheets, arranged in the same order. If a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
7. Drawings executed at an appropriate scale, not smaller than $\frac{1}{8}" = 1'-0"$ for conduit/floor plans, $\frac{1}{4}" = 1'-0"$ for equipment layouts, and $\frac{1}{2}" = 1'-0"$ for mounting details and plate/panel details.

E. Submittal Copies:

1. These requirements represent minimum project requirements; a project's general conditions may require additional copies for project distribution.
2. Electronic submission of submittals is encouraged. Where non-electronic documents are required, submit all documents electronically in PDF format.
3. Where hardcopy submittals may be required,
 - a. Submit (3) bound prints of all drawings.

4. Submit (3) copies of bound materials (e.g. product data.)
 - a. Submit (2) sets of any product or sample finishes as required within this specification.

- F. Resubmission Requirements:
 1. Make any requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
 2. Indicate any changes that have been made other than those requested.

- G. Approval of Submittals: The submittal information will be reviewed by the general contractor, owner, Architects, engineers, and consultant. Each submittal package will be returned, stamped as follows:
 1. “No Exceptions Taken” proceed with construction, all job site coordination will be at the direction of the general contractor.
 2. “Make Corrections Noted: No Resubmission Required” submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made before construction can begin.
 3. “Make Corrections Noted: Submit Corrected Copy” submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made in writing and returned to the consultant before construction can begin.
 4. “REJECTED, Submit Specified Item” a specified item in the submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
 5. “REJECTED, Revise and Re-submit” submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
 6. “No Review Action Required” all information provided was for information or coordination purposes only. Review is not required.

1.9 PROJECT RECORD MANUAL

- A. Submit three bound original sets (this is a minimum of two for the Owner and one for the Architect’s consultant; additional copies may be required by the project’s general conditions) after substantial completion and prior to final inspection.

- B. The Project Record Manual shall be segregated into three separate bindings as follows:
 1. Operations Manual:
 - a. Product Data: Product actually incorporated within the Work:
 - 1) Manufacturer's data for each type of product conforming to the scheme above. The list shall include manufacturer’s serial numbers.
 - 2) Owner/Instruction Manual for each product.
 - 3) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
 - 4) Manufacturer's wiring diagram for each type of product actually incorporated.
 - 5) Separately bound list by manufacturer and model or part number of all products incorporated within the Work arranged in alphanumeric order.
 - b. Record drawings: Final rendition of that specified depicting what is actually incorporated within the Work. Provide one (1) full size set and one (1) DVD containing all CAD generated drawings prepared in conjunction with this project. Drawing files to be in AutoCAD Release 2010 or above DWG format.
 - c. Test Reports: Recorded findings of testing specification of this specification.
 - d. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
 - 1) This procedure should describe the operation of all system capabilities.

- 2) Assume the intended reader of the manual to be technically experienced but unfamiliar with the components and the facility.
2. Service & Maintenance Manual:
 - a. Provide an original copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. Arrange manuals in the same order as the operations manual.
 - b. Manufacturer's maintenance and care instructions.
 - c. Maintenance Instructions, including maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
 - d. Replacement parts list of all minor equipment such as fuses, lamps, connectors, knobs, etc.
3. Warranty Manual:
 - a. Manufacturer's warranty statements on each product.
 - b. Date of substantial completion and ending dates for warranties for each group of products.
 - c. Software registration and licenses.
- C. Include any other pertinent data generated during the Project or required for future service.
- D. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Ship product in its original container, to prevent damaging or entrance of foreign matter.
- B. Handling and shipping in accordance with manufacturer's recommendation.
- C. Provide protective covering during construction, to prevent damaging or entrance of foreign matter.
- D. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.

1.11 PROJECT CONDITIONS

- A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The Drawings diagrammatically show arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the work may be installed.

1.12 FINAL INSPECTION AND TESTING

- A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final inspection and test will be observed by the Architect and/or Architect's Consultant no earlier than two weeks after receipt of the written results.
- B. Provide a minimum of one (1) person for inspection to assist the Owner.

- C. The process of testing the System may necessitate moving and adjusting certain components such as adjustment of drapery tracks, etc.
- D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
- E. The following procedures will be performed on each System:
 - 1. Inspection of the methods and means employed to incorporate the System within the facility.
 - 2. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications settings within the Record Documents.
 - 3. Other tests on equipment or systems deemed appropriate.
- F. In the event the need for further adjustment or work becomes evident during testing, the Tension Grid Systems Contractor is to continue work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the inspection and testing period is required, the contract price will be reduced for the additional time and expenses of the Owner, at the standard rate in effect at that time. All additional re-punch trip costs shall be at the Consultant's standard rate and the responsibility of the tension grid contractor.

1.13 WARRANTY

- A. Warrant labor and product for five (5) years following the date of substantial completion to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or product within the Warranty period without charge. Any cost required to complete this warranty repair is the responsibility of the contractor.
- B. This warranty is in addition to any specific warranties issued by manufacturers for greater periods of time.
- C. Within the warranty period, answer service calls within eight hours, and correct the deficiency within twenty-four hours.

1.14 INSTRUCTION OF OWNER PERSONNEL

- A. After final completion provide instruction to Owner and/or the Owner's designated personnel on the use, operation, maintenance and care of the System.
- B. Develop training course based on the use of the System and manufacturers' recommendation. Provide four (5) hours of training. All training shall be scheduled at the convenience of the owner and designated personnel.
- C. Submit an outline of the course with sample instructional aides for approval thirty days (30) prior to scheduled instruction sessions.
- D. If a representative of the manufacturer is used in the instructional course, the Tension Grid Systems Contractor must be present throughout the extent of the course and ensure that the representative abides by the requirements set forth in these specifications.

2.1 ACCEPTABLE MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed to establish a standard of product quality.
- B. Substitution of specified products with other qualified manufacturers and products will be considered providing:
 - 1. Proper substitution procedures outline under Division 1 is adhered to.
 - 2. A request for substitution of each specific product must be made in writing by a bidding Contractor not less than ten (10) business days prior to bid for written approval of the Architect.
 - 3. Sufficient data of the products is presented for prior approval including technical data, manufacturer's specifications, samples, and, if requested, results of independent testing laboratory tests.
 - 4. Written permission is obtained for the substitution from the Owner or Owner's Representative.
- C. If proposed system includes equipment other than specified model numbers, submit a list of major items and their quantities, with a one-line schematic diagram for review. Include a list of previously installed projects using proposed equipment that are similar in nature to specified System.
- D. Provide product not specifically specified commensurate with the quality and standards established by the specified product.

2.2 GENERAL

- A. Products shall be new, free from defects and listed by UL when an applicable UL Standard exists. Provide product of a given type from one manufacturer.
- B. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturers' published specifications.

2.3 CONTACTS

- A. Listed below is contact information for manufacturers of tension wire grid systems approved to provide equipment on this project:
 - 1. InterAmerica Stage, Inc.
 - a. 4300 St. Johns Parkway, Sanford FL, 32771
 - b. Telephone: 407-302-0881
 - 2. Texas Scenic Company
 - a. 5423 Jackwood Drive, San Antonio, TX 78238
 - b. Telephone (210) 684-0091
 - 3. SkyDeck
 - a. 5401 Benchmark Ln, Sanford, FL 32773
 - b. Telephone (407) 302-0881

2.4 TENSION GRID

- A. General:
 - 1. The tension grid structure shall consist of a series of rectilinear panels fabricated of structural steel shapes that constitute a frame for a woven wire rope mat.

2. The panels shall be suspended from the structure so that they can provide a walking surface for trained stage personnel.
 3. The panels shall be fabricated at a manufacturer's location and shipped to the jobsite.
 4. The nominal size of the panels shall be as described on the drawings. Precise dimensions shall be based on the spacing of the structural members that support the grid structure.
 5. The maximum deflection of the woven wire rope surface shall not be greater than L/80 under a 150 pound point load.
 6. The designed live load for the grid shall be 25 pounds per square foot and 300 pounds per square foot over 1 square foot.
- B. Grid Panels:
1. The frame of each grid panel shall be fabricated of ASTM grade A-36 structural steel shapes. Size of frames is to be determined by the structural spacing and projected load.
 2. Frame shall have continuous butt welds at each 90 degree corner; corners shall be chamfered to provide clearance for suspension members.
 3. Frame shall be drilled and de-burred to provide attachment of the woven wire rope segments. All cable holes shall be in the upper half of each frame.
 4. Weld lateral bracing stiffeners between the web of each channel across the frame as necessary to prevent buckling or deformation.
 5. Maximum frame compression on any member shall be 5000 pounds.
 6. Grid panels shall be factory coated in a durable black enamel finish.
- C. Wire Rope Grid Surface:
1. The panel surface is constructed of two perpendicular sets of 1/8" diameter wire ropes. Each set of wire ropes shall be interwoven forming a mesh of wire ropes spaced at a nominal 2-inches on center. The weave of each wire rope shall pass above each crossing cable then below the next crossing cable, repeating until the cable reaches the opposite frame of the grid panel. Parallel cables shall be woven opposite the cables next to it.
 2. Where any frame has an angled face, provide bolted connections with appropriate beveled washers to assure flat seating of the fittings.
 3. Termination of Wire Rope
 - a. Wire ropes shall be terminated with corrosion-resistant threaded studs at each end.
 - b. Terminations shall be factory swaged and shall be rated to exceed the breaking strength of the wire rope.
 - c. Wire rope ends shall be secured to frames with a pair of rated nuts on each side of the hole and shall lock the stud in place. Secure swaged stud fitting in place with one flat washer and one nylon locking nut.
 - d. All wire rope should be tensioned equally and verified by using a torque wrench or similar means.
 4. Each wire rope shall be of a continuous length, free of knots, kinks, or splices.
 5. Wire rope shall be 1/8" diameter 7 x 19 galvanized and blackened cable. Cable shall be rated at not less than 2000 pound breaking strength.
 6. Wire rope shall be factory coated black.
- D. Grid Hangers
1. Tension members shall be engineered, fabricated, and installed to support the required loads. Hangers shall also be used as anchorages for the integrated lighting and handrail system and shall have an outside diameter equivalent to ASTM A53/A nominal 1-1/2" I.D. Schedule 40 plain end steel pipe.
 2. All hangers should be securely attached to the overhead structure using hardware rated for the purpose.

3. Hangers shall support the panels from beneath the frame and securely attach to the frame using a bolted connection.
4. Hangers shall be designed to accommodate irregularities in the building framing system above while allowing the grid elements to be installed plumb, square and cleanly aligned with one another.
5. The hangers shall be finished with a durable black enamel finish.

E. Hardware:

1. All bolts and fasteners shall be grade 5 or better.
2. All bolted attachments shall have lock washers or other approved self-locking hardware.

F. Acceptable Product:

1. SkyDeck by InterAmerica, Stage Inc., or approved equal.

2.5 PIPE GRID AND RAILING SYSTEM:

A. Provide a grid fabricated and installed as shown on the drawings.

1. Grid segments will be constructed of new ASTM A53/A nominal 1-½" I.D. Schedule 40 plain end steel pipe.
2. Segments exceeding one standard pipe length will be joined using an internal splicing sleeve. Splices must provide the same overall capacity, deflection, and strength to the pipe battens as an un-spliced span. Threaded couplers are not permitted.
 - a. Splice sleeves shall be a minimum of 24-inches length with a minimum of 12-inches extending into each pipe segment.
 - b. Sleeves will be machined to a diameter that will create a snug fit within the pipe segments.
 - c. Splicing sleeves will be fastened to the pipe segment with pins or ¾" diameter bolts. Locate at least two fasteners on each side of splice joint; alternate direction of fasteners at right angles to one another across the diameter of the pipe.
3. Any fasteners used on pipe segments must meet SAE grade 5, and be equipped with self-locking nuts.
4. All pipe shall be finished with a durable black enamel finish.
5. Provide supplemental loose pipe segments for user application.
 - a. Length : 10 ft.
 - b. Quantity : twenty (20)
 - c. Length : 8 ft.
 - d. Quantity : twenty (10)

B. Grid Suspension and Connections

1. Pipe grid shall be suspended from overhead structure using load-rated crossover clamps onto the tension grid hangers as specified in the drawings. Where intermediate supports are required, supply additional ASTM A53/A nominal 1-1/2" I.D. Schedule 40 plain end steel pipe hangers attached to overhead structure.
2. Additional connections may require load rated beam clips if attaching to steel members. If attaching to a concrete pan, provide a load rated shaped bracket to be attached using Hilti fastener or drilled epoxy filled expansion bolts. Provide 3/8" load rated threaded rod to connect from structure mounted hardware to clevis hanger that shall support the pipe grid.
3. Any bolts used on pipe battens will be equipped with self-locking fasteners.
4. Provide load rated crossover clamps at each intersection of pipe.

C. Swivel Pipe Clamps

1. Provide supplemental pipe/tubing clamps to allow additional pipe segments to be added to the grid as required.

2. Clamps shall be swivel-type and shall lock onto each pipe-segment with a hinged-clamshell action secured by locking nuts on each segment half.
 - a. Quality/Safety Certifications: BS1139 (1982 & 1991), EN74 class A & B
 - b. Dimensions: 48.3 x 48.3mm (1 29 / 32" x 1 29 / 32")
 - c. Material: drop forged carbon steel with T-bolt
 - d. Style: flanged
 - e. Tube sizes: 1-1/4" through 1-1/2" nominal diameter sch. 40 pipe.
 - f. Finish: galvanized; painted black
 - g. Quantity (50)

D. Tension Grid pass throughs

1. Provide (12) grid protective sleeves fabricated of durable polyurethane that may be installed within the 2" wire tension grid for production-based rigging and drapery purposes. The sleeves shall be relocatable and shall not require any fasteners for installation to secure.
 - a. Finish: Black
 - b. Quantity: (12)

2.6 RIGGING ACCESSORIES:

1. In certain instances special component parts, such as mule blocks, idler blocks, extra lines, etc., shall be necessary in order to provide a fully operable system. Where such requirements are necessary, furnish these components comparable to the quality of the products specified in these specifications.
2. Acceptable manufacturers:
 - a. H&H Specialties
 - b. Wenger (JR Clancy)
 - c. Crosby
 - d. InterAmerica Stage, Inc.
 - e. Thern Stage Equipment, Inc
 - f. Texas Scenic Company

2.7 COMPLETED SYSTEM

A. General

1. All installation of stage rigging equipment shall be completed utilizing new materials, free from flaws and rust, and in good working order. The jobsite shall be cleaned of all packing materials, lubricants, metal shaving, miscellaneous hardware, and components not used in the installation.
2. All dimensions are to be field verified. Location and attachment of hardware and size of components shall be confirmed by the Tension Grid Systems Contractor.
3. All electrical power, outlets, related systems, and structural elements required to make the system fully functional are the responsibility of the contractor.
4. If components and hardware are not specifically specified or called out, it is the responsibility of the contractor to provide those components in order to provide a fully operational tension grid system.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.
- B. Mount equipment and enclosures plumb and level.

- C. Permanently installed equipment to be firmly and safely held in place in accordance with specified safety factors and Federal and State codes and regulations.
- D. Work shall be completed within industry guidelines, including, PLASA, OSHA, ESTA National Electric Code, American National Standards Institute, American Society for Testing and Materials, American Institute of Steel Construction, National Fire Protection Association, National Electrical Manufacturers Association, plus any or all local, governmental, or other applicable codes.
- E. All stage rigging work must be supervised or performed by a minimum of one ETCP Certified Rigger.
- F. Where dimensions and loading capacities have been omitted from this specification, they are to be determined by the Tension Grid Systems Contractor, in accordance with the accepted industry standards and guidelines in this section. In no way will Tension Grid Systems Contractor be relieved of primary responsibility to provide a safe, fully functional system.
- G. The mechanical fabrication and workmanship will incorporate the best practices for good fit and finish. There will not be any burrs or sharp edges to cause a hazard nor will there be any sharp corners accessible to personnel.
- H. All equipment will be installed based on the manufacturer's recommendations and for the use intended by the manufacturer.
- I. All shop and field welding will meet the qualifications of the AISC manual and will be without spatter or other evidence of poor practices.
- J. All finishes which are disturbed during shipping and installation will be touched up to match the original.
- K. Materials will conform to the following ASTM standard specifications:
 - 1. A-36 structural steel
 - 2. A-36 steel plates and bars
 - 3. A-47 malleable iron casting
 - 4. A-48 gray iron casting
 - 5. A-53 steel pipe
 - 6. A-120 black and hot-dipped for ordinary use.
- L. In order to establish minimum standards of safety, the following factors will be used:
 - 1. cables and fittings provide an 8 safety factor
 - 2. cable bending ratio is 30 times the cable diameter
 - 3. nuts and bolts use minimum SAE grade 5 (ASTM rating A-449)
 - 4. thread pressure of
 - a. 500 lb. for cast iron
 - b. 1000 lb. for steel
 - c. 1500 lb. for Nylatron
 - 5. Steel to 1/5 of yield

3.2 LABELING OF EQUIPMENT

- A. Mark and label each batten with its set number, load/arbor capacity, stage centerline, and lift line locations with appropriate paint.

- B. Provide labels clearly indicating date of manufacture, cloth type, manufacturer's name and address, size (width and height using 3/4" minimum lettering), and Owner's designated inventory number (to be coordinated with Owner) will be sewn into the back (in most cases, upstage) side of the upper hem at both ends of each drape panel.

3.3 CONTRACTOR COMMISSIONING

- A. Prior to energizing or testing the System ensure the following:
 - 1. Products are installed in proper and safe manner according to manufacturer's instructions.
 - 2. Dusts, debris, solder splatter, etc. is removed.
 - 3. Labeling has been provided.
 - 4. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
 - 5. Products are neat, clean and unmarred and parts securely attached.
 - 6. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded. Job site shall be left broom clean.
- B. Provide two portable VHF or UHF business band radios for use during acceptance testing with transmission range sufficient to cover entire project.
 - 1. Include rechargeable batteries and re-charger along with "holster" for wearing on belt.
 - 2. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

END OF SECTION 11 61 23

SECTION 11 61 24 - PORTABLE STAGING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. To provide a portable seating and staging system for the St. Phillip's Watson Fine Arts Center Black Box addition.

1.2 RELATED DOCUMENTS

- A. Architectural Drawings
- B. Theatrical Rigging (TR-series)
- C. General provisions of the contract including general and supplementary conditions and Division 1 Specification sections apply to this section.

1.3 SECTION INCLUDES

- A. Coordination, provision, installation, inspection, commissioning, testing, documentation, instruction and warranties of the portable staging systems.
- B. Plant, materials, equipment, transport and labor necessary to accomplish this and have a complete and proper System.
- C. Also includes:
 - 1. Required licenses and permits including payment of charges and fees.
 - 2. All fees for testing, documenting, and notary public services.
 - 3. Verification of dimensions and conditions at the job site.
 - 4. Provision of required pre-installation submittals and project record manuals.
 - 5. Installation in accordance with the contract document, manufacturer's recommendation, and in conformity with applicable codes and authority having jurisdiction.

1.4 RELATED WORK

- A. Division 09: Section "Wood Flooring" for wood stage flooring materials, installation, and finishing requirements.

1.5 REFERENCES

- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
 - 1. American National Safety Institute (ANSI),
 - 2. American Society of Testing and Materials (ASTM),
 - 3. American Hardboard Association (AHA):
 - 4. Occupational Safety and Health Administration (OHSA),
 - 5. NFPA International (NFPA)
 - 6. United States Institute of Theatre Technology (USITT).
 - 7. Entertainment Services and Technology Association (ESTA).

1.6 DESCRIPTIONS AND REQUIREMENTS

- A. The following is intended to further describe the Work and clarify design intent and is not an exhaustive description of the portable staging systems.

- B. Black Box Seating Risers and Portable Staging
 - 1. Provide an interlocking system of portable seating platforms suitable to allow the minimum configurations as indicated on the drawings.
 - 2. Provide fixed and telescoping leg sets as required to accommodate the seating layouts described in the drawings.
 - 3. Provide all safety railings, bracing and supplemental supports and hardware needed for a complete and safe system.
 - 4. Refer to the Architectural-series drawings for layouts.

1.7 RESPONSIBILITY AND RELATED WORK

- A. The drawings included with this specification convey general system concepts. The plans do not show complete and accurate building details. The Installer is responsible for making field measurements necessary to establish exact locations, relationships, load capacities necessary for the installation of these systems.
- B. The installer shall coordinate the work with the General and other related contractors and the scheduled work of other trades.
- C. Supply accessories and minor equipment items needed for a complete system, even if not specifically mentioned in these Specifications or on the associated Drawings, without claim for additional payment.
- D. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the portable staging systems installer to supply systems in full working order. Notify the Architect of any discrepancies in part numbers or quantities before bid. Failing to provide such notification requires portable staging systems installer to supply items and quantities according to the intent of the Specifications and associated Drawings without claim for additional payment.
- E. Obtain all permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner including any associated charges or fees.
- F. Execute all work in accordance with all Standard Authorities listed above, and all applicable State and Local codes, ordinances, and regulations. If a conflict develops between the contract document and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

1.8 QUALITY ASSURANCE

- A. Contractor's Qualifications: Firm experienced in the provision of systems similar in complexity to those required for this project; and meet the following:
 - 1. No less than five years of experience with equipment and systems of the specified types.
 - 2. Experience with at least five comparable scale projects within the last two years.
 - 3. Be a franchised dealer and service facility for the manufacturer's products furnished.
 - 4. Maintain a fully staffed and equipped service facility.
 - 5. At the request of the Architect, demonstrate that:
 - a. Adequate plant and equipment is available to complete the work.
 - b. Adequate staff with commensurate technical experience is available.
- B. Manufacturer's Qualifications: No less than 5 years continuous experience in the production of specified types of product.

- C. Contractor shall attend pre-installation meetings to coordinate with other trades as required.

1.9 WARRANTY

- A. Warrant labor and product for two (2) years following the date of substantial completion to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or product within the Warranty period without charge. Any cost required to complete this warranty repair is the responsibility of the contractor.
- B. This warranty is in addition to any specific warranties issued by manufacturers for greater periods of time.
- C. Within the warranty period, answer service calls within eight hours, and correct the deficiency within twenty-four hours.

1.10 SUBMITTALS:

- A. Provide submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures section unless otherwise indicated.
- B. The submittal information required by the specification is to be presented complete and as submissions noted below. Submittals are a crucial and integral part of the construction process; as such the Owner's consultant will not recommend payment to the Contractor above 25% of the scheduled value of this work until all submittal information has been approved.
- C. Submittals must be original work produced by the firm responsible for performing the work defined in this specification. Scanning, photographic copying, materially copying, or any other reproducing the contents of the drawings or specifications contained within the Contract Documents will be marked as unacceptable and not reviewed for any content. No claim shall be made for delay, undue burden, or additional costs for the effort to produce shop drawings, schedules, and equipment lists addressing this specification or the overall project manual.
- D. Project Submittal Part 1:
1. Provide for approval not later than thirty (30) days after issuance of Notice to Proceed and prior to commencement of Work:
 - a. Section 1: A complete schedule of submittals.
 - b. Section 2: A chronological schedule of Work in bar chart form. Revise and resubmit schedule as required to reflect construction progress.
- E. Project Submittal Part 2:
1. Provide for approval no later than sixty (60) days after issuance of Notice to Proceed and in accordance with previously submitted submittal schedule.
 2. Products:

- a. Section 1: Complete list of products to be incorporated within the Work (Bill of Materials).
 - b. Section 2: Manufacturer's data sheets for each product.
 - 1) Provide original manufacturer's data sheets in order as they appear in the specification.
 - 2) Data sheets are required for each product in sufficient detail to evaluate product suitability for incorporation within the Work.
 - 3) Product literature shall include documentation of UL Listing or approved recognition by a Nationally Recognized Testing Laboratory (NRTL).
 - c. Section 3: Provide Architect and/or Architect's Consultant with samples of wall plate materials and colors as specified in this section.
 - d. Section 4: Submit Safety Data Sheets (SDS) for each potentially hazardous material prior to use. Include information pertaining to the hazardous material with the SDS.
3. Drawings:
- a. Provide computer software generated drawings using standard industry graphic standards. Hand or poorly drawn documents will not be accepted. All drawings shall be created on a computer aided drafting (CAD) system. Electronic files of theatrical lighting contract documents shall not be distributed for use in generating submittal documents with the exception of Architectural backgrounds.
 - b. Schematic Drawings.
 - 1) Provide drawings detailing cabling-riser intent.
 - 2) Give each component a unique designator and use this designator consistently throughout the project.
 - 3) Include inter- and intra-component connections and cabling diagram depicting cable types, designators, and color codes.
 - c. Installation Drawings.
 - 1) Provide drawings showing the coordinated locations of all installed equipment. Drawings shall include floorplans and other views as necessary to fully describe the intended finished conditions.
 - 2) Provide Conduit and Electrical Drawings indicating:
 - a) Conduit sizing/routing for each system component,
 - b) Locations where power is required along with the location of all junction boxes.
 - 3) Detail Drawings: Provide drawings showing special details depicting methods and means specific to each product, assembly and each product Manufacturer's recommended installation methods and means.
 - d. Equipment Drawings:

- 1) Rack and Panel Elevations: Provide a front elevation of all racks and/or panels.
 - 2) Rack and Panel Assembly Details: Provide drawings showing location of equipment in racks with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations.
 - 3) Custom Enclosures and Millwork Drawings: Provide full fabrication detail drawings indicating size, material, finish, and openings for equipment.
 - 4) Fabricated Plates and Panels Drawings: Provide complete drawings of custom fabricated plates or panels. Drawings to include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
- e. Schedule Drawings: Provide load schedules noting source and destination of wiring and associated connected load.
 - f. Labeling Drawing: Provide representative equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and descriptor and designator schedule.
 - g. General Detail Drawings: Provide detail drawings depicting any unique installation methods specific to each product.
 - h. Control Screen Templates: Provide layout drawings and/or screenshots for master house lighting stations and similar electronic control surfaces.
4. Any other pertinent data generated which is necessary to provide the Work.

F. Submittal Format:

1. Electronic (PDF) submittal documents are required for review.
2. Provide each submittal with a unique number and each shall be numbered in consecutive order.
3. Submittals shall not be issued with other disciplines.
4. Provide each submittal with a complete table of contents with the following information:
 - a. Project Name
 - b. Submittal number. In the case of a resubmittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and shall be numbered in consecutive order.
 - c. Date of submission.
 - d. Referenced specification Section, Part, Article, Paragraph, and page number or drawing reference as applicable.
5. Follow list by Manufacturer's data sheets, arranged as in Part 2 of this specification. If a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
6. Drawings executed at an appropriate scale, but not smaller than 1/8" = 1'-0".

G. Resubmission Requirements:

1. Make any requested corrections or change in submittals required. Resubmit for review as directed.
2. Indicate any changes that have been made other than those requested.
3. Approval of Submittals: Each submittal package will be returned with one of the following stamps:
 - a. “No Exceptions Taken” proceed with construction; all job site coordination will be at the direction of the General Contractor.
 - b. “Make Corrections Noted: No Resubmission Required” submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made before construction can begin.
 - c. “Make Corrections Noted: Submit Only Corrected Pages/Items” submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made in writing and returned to the consultant before construction can begin.
 - d. “REJECTED, Submit Specified Item” a specified item in the submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
 - e. “REJECTED, Revise and Re-submit” submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
 - f. “No Review Action Required” all information provided was for information or coordination purposes only. Review is not required.
4. Any of the above stamps may also carry a “PARTIAL” stamp. This indicates that required information noted in the section above was not provided. Omitted items may be noted as part of the reviewed submittal, but it is the Contractor’s responsibility to verify all required submittal documentation.

1.11 PROJECT RECORD MANUAL

- A. Submit three bound original sets (this is a minimum of two for the Owner and one for the Architect’s consultant; additional copies may be required by the project’s general conditions) after substantial completion and prior to final inspection.
- B. The Project Record Manual shall be segregated into three separate bindings as follows:
 1. Operations Manual:
 - a. Product Data: Product actually incorporated within the Work:
 - 1) Manufacturer’s data for each type of product conforming to the scheme above. The list shall include manufacturer’s serial numbers.
 - 2) Each products Owner/Instruction Manual.
 - 3) Separately bound list by manufacturer and model or part number of all products incorporated within the Work arranged in alphanumeric order.
 - b. Record drawings: Provide one (1) full size set and one (1) DVD containing CAD generated drawings prepared in conjunction with this project. Drawing CAD files are to be in AutoCAD release 2010 dwg format
 - c. Test Reports: Recorded findings of testing specification of this specification.
 - d. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.

- 1) This procedure should describe the operation of all system capabilities.
 - 2) Assume the intended reader of the manual to be technically experienced but unfamiliar with the components and the facility.
2. Service & Maintenance Manual:
 - a. Provide an original copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. Arrange manuals in the same order as the operations manual.
 - b. Manufacturer's maintenance and care instructions.
 - c. Maintenance Instructions, including maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
 - d. Replacement parts list of all minor equipment such as fuses, lamps, connectors, knobs, etc.
 3. Warranty Manual:
 - a. Manufacturer's warranty statements on each product.
 - b. Date of substantial completion and ending dates for warranties for each group of products.
 - c. Software registration and licenses.
- C. Include any other pertinent data generated during the Project or required for future service.
- D. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed to establish a standard of product quality.
- B. Substitution of specified products with other qualified manufacturers and products will be considered providing:
 1. Proper substitution procedures outline under Division 1 is adhered to.
 2. A request for substitution of each specific product must be made in writing by a bidding Contractor not less than ten (10) business days prior to bid for written approval of the Architect.
 3. Sufficient data for each product is presented for prior approval including technical data, manufacturer's specifications, samples, and, if requested, results of independent testing laboratory tests.
 4. Written permission is obtained for the substitution from the Owner or Owner's Representative.
- C. If proposed System includes equipment other than specified model numbers, submit a list of major items and their quantities, with a schematic diagram for review. Include a list of previously installed projects using proposed equipment that are similar in nature to specified System.
- D. Provide product not specifically specified commensurate with the quality and standards established by the specified product.

2.2 GENERAL

- A. Products shall be new, free from defects and listed by UL when an applicable UL Standard exists. Provide product of a given type from one manufacturer.

- B. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturers' published specifications.

2.3 SEATING AND STAGING PLATFORM SYSTEM

- A. Provide a portable platform system suitable for audience seating or to serve as a performance stage.
- B. Decks:
 - 1. Each deck sub-floor shall be 1" [25 millimeters] thick APA AC rated plywood. Finish surfaces available shall be:
 - a. Black thermally fused overlay embossed with raised, textured circles. Backer material shall be thermally fused HDO overlay.
 - b. 1/8" (0.32 cm) tempered hardboard outer plies with a natural, mill finish.
 - c. Manufacturer's standard grey carpet or color as selected by the Architect.
- C. Frame:
 - 1. Frame shall be constructed of 6063 structural aluminum with a natural finish. The extrusion shall be a box design for maximum strength and rigidity, with special grooves to protect the top surface edge, connect adjacent platforms, and to attach all accessories. The overall thickness of the finished platform shall be nominal 4-inch..
- D. Guardrails:
 - 1. 1 ¼" inch (32 millimeters) Schedule 40 6105-T6 aluminum or steel extrusion.
 - 2. Finish: Mill, Anodized or Powder Coat finish.
 - 3. Toeboard: 4 inch (102 millimeters) extruded aluminum toeboard where required by code.
 - 4. Equip guardrail with locking mechanism to allow for attachment to deck. Design lock mechanism to allow for easy removal.
 - 5. Provide manufacturer's standard guardrails.
 - a. IBC compliant guardrail: Space vertical members so that no sphere 4 inches (102 millimeters) in diameter or larger may pass through.
- E. Supplemental Steps
 - 1. Provide 6-rise steps to fasten at each aisle in the seating plan.
 - 2. Quantity: minimum (16)
- F. Single Height Legs:
 - 1. Provide quantity as required to allow 1ft rise between seating levels for the configurations as described on the drawing.
 - 2. Provide all required cross-bracing and accessories.
- G. Telescoping Legs:
 - 1. Provide additional 16"-28" telescoping leg sets
 - 2. Provide additional 24"-40" telescoping leg sets
 - 3. Quantity (24) of each height
- H. Provide platform quantities and nominal sizes to allow all the configurations as described on the drawings. Quantities to support (200) chairs and audience members.
- I. Provide Black Curtain Skirting for all platforms at all heights
- J. Provide legs and aluminum extruded rails for platform shall be powder coated black.
- K. Acceptable product
 - 1. Staging Concepts Staging System

2. Wenger StageTek Staging System,

2.4 TRANSPORT CARTS

- A. Leg and bracing cart
 1. Material: Tubular steel with welded joints. Grind weld joints smooth.
 2. Casters: Provide 4 casters for each cart; 2 fixed and 2 swivel.
 3. Caster Sizes: 4 inch (102 millimeters) or 6 inch (152 millimeters) diameter, with a load capacity of 900 pounds (408.23 kilograms) each.
 4. Provide pivoting ramp to lock into position with hitch pins.
 5. Provide pivoting cross members to lock in position with hitch pins.
 6. Provide straps to hold leg supports during transport.
 7. Design transport carts to contain intended load in a secure and organized manner.
 8. Carts shall provide storage for any legs, bracing, or axillary components necessary for platform assembly or usage.
- B. Platform cart
 1. Material: Tubular steel with welded joints. Grind weld joints smooth.
 2. Casters: Provide 4 casters for each cart; 2 fixed and 2 swivel.
 3. Caster Sizes: 4 inch (102 millimeters) or 6 inch (152 millimeters) diameter, with a load capacity of 900 pounds (408.23 kilograms) each.
 4. Design transport carts to contain intended load in a secure and organized manner.
- C. Quantity as required to hold complete contents of the specified system.

2.5 COMPLETED SYSTEM

- A. General
 1. All installation of the pit filler components shall be completed utilizing new materials, free from flaws and rust, and in good working order. The jobsite shall be cleaned of all packing materials, lubricants, metal shaving, miscellaneous hardware, and components not used in the installation.
 2. All dimensions are to be field verified. Location and attachment of hardware and size of components shall be confirmed by the installer.
 3. If components and hardware are not specifically specified or called out, it is the responsibility of the contractor to provide those components in order to provide fully operational portable staging systems.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.
- B. Mount equipment and enclosures plumb and level.
- C. Permanently installed equipment to be firmly and safely held in place in accordance with specified safety factors and Federal and State codes and regulations.
- D. Work shall be completed within industry guidelines, including, ESTA, OSHA, ANSI, ASTM, NFPA, plus any or all local, governmental, or other applicable codes.
- E. Where dimensions and loading capacities have been omitted from this specification, they are to be determined by the installer, in accordance with the accepted industry standards and

guidelines in this section. In no way will the installer be relieved of primary responsibility to provide a safe, fully functional system.

- F. The mechanical fabrication and workmanship will incorporate the best practices for good fit and finish. There will not be any burrs or sharp edges to cause a hazard nor will there be any sharp corners accessible to personnel.
- G. All equipment will be installed based on the manufacturer's recommendations and for the use intended by the manufacturer.
- H. All finishes which are disturbed during shipping and installation will be touched up to match the original.
- I. Materials will conform to the following ASTM standard specifications:
 - 1. ASTM B 209: Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2. ASTM B 221: Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 3. ASTM B 429: Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

3.2 PROJECT CONDITIONS

- A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The Drawings diagrammatically show arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the work may be installed.

3.3 DELIVERY, STORAGE, AND HANDLING

- A. Ship product in its original container, to prevent damaging or entrance of foreign matter.
- B. Handling and shipping in accordance with manufacturer's recommendation.
- C. Provide protective covering during construction, to prevent damaging or entrance of foreign matter.
- D. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.

3.4 INSTALLATION OF PIT FILLER

- A. Install all hardware according to manufacturer's recommendations.
- B. Level the pit filler and attach all attachment brackets. Attach platforms to the pit wall, as required.
- C. Clearly label all sections and mark footing locations on floor with permanent application. Provide documentation to owner showing exact locations for future re-installation.
- D. After installing the pit filler, thoroughly sweep to remove dust, visible dirt, etc. Paint and finishes shall be touched-up if required.
- E. Remove all packing materials from the jobsite.

3.5 CONTRACTOR COMMISSIONING

- A. Prior to testing the System ensure the following:
 - 1. Products are installed in proper and safe manner according to manufacturer's instructions.
 - 2. Dust, debris, etc. is removed.
 - 3. Labeling has been provided.
 - 4. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
 - 5. Products are neat, clean and unmarred and parts securely attached.
 - 6. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded. Job site shall be left broom clean.

3.6 FINAL INSPECTION AND TESTING

- A. Upon completion of installation, initial adjustments, tests and measurements specified above, and submission and review of the results, a final inspection and test will be observed by the Architect and/or Architect's Consultant no earlier than two weeks after receipt of the written results.
- B. Provide a minimum of one (1) person for inspection and testing familiar with aspects of the System to assist the Owner and the Owner's Consultant.
- C. The process of testing the System may necessitate moving and adjusting certain components.
- D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
- E. The following procedures will be performed on each System:
 - 1. Inspection of the methods and means employed to incorporate the System within the facility.
 - 2. Verification of proper operation, including leveling and stability of the installation.
 - 3. Verification of proper adjustment, balance, and alignment of equipment
 - 4. Verification that all labeling and normal settings are established and appropriately record these settings within the Record Documents.
 - 5. Other tests on equipment or systems deemed appropriate.
- F. In the event the need for further adjustment or work becomes evident during testing, the Installer is to continue his work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the inspection and testing period is required, the contract price will be reduced for the additional time and expenses of the Owner, at the standard rate in effect at that time.

3.7 INSTRUCTION OF OWNER PERSONNEL

- A. After final completion provide instruction to Owner and/or the Owner's designated personnel on the use, operation, maintenance, and care of the System.
- B. Develop training course based on the use of the System and manufacturers' recommendations. Provide four (4) hours of training. The training may be scheduled in a single session.

- C. Provide videotaped documentation of all training. Provide owner with copy of the audio-visual recording in the owner's preferred format.
- D. All training shall be scheduled at the convenience of the owner and designated personnel.
- E. If a representative of the manufacturer is used in the instructional course, the portable staging systems installer must be present throughout the extent of the course and ensure that the representative abides by the requirements set forth in these specifications.

END OF SECTION 11 61 24

SECTION 11 61 33 – THEATRICAL RIGGING SYSTEMS

PART 1 - GENERAL

1.1 SECTION SUMMARY

- A. This specification describes the installation of the theatrical rigging equipment and stage drapery tracks at the St. Phillip's Watson Fine Arts Center Black Box addition.
- B. Related Documents
- C. Theatre Rigging Drawings ("TR" Series) and general provisions of the contract including general and supplementary conditions and Division 1 Specification sections apply to this section.

1.2 SECTION INCLUDES

- A. Coordination, provision, installation, inspection, commissioning, testing, documentation, instruction and warranties of Theatrical Rigging Systems.
- B. Plant, materials, equipment, transport and labor necessary to accomplish this and have a complete and proper System.
- C. Also includes:
 - 1. Required licenses and permits including payment of charges and fees.
 - 2. Any required fees for testing, documenting, and notary public services.
 - 3. Verification of dimensions and conditions at the job site.
 - 4. Provision of required pre-installation submittals and project record manuals.
 - 5. Installation in accordance with the contract document, manufacturer's recommendation, and in conformity with applicable codes and authority having jurisdiction.
 - 6. Extension of electrical service, including ground, to equipment locations.

1.3 RELATED WORK

- A. Section 11 61 43: Stage Draperies.
- B. Section 26 55 61: Theatrical Lighting and Controls.
- C. Section 27 41 16: Integrated Audio-Video Systems.
- D. Division 26: Electrical Work.

1.4 REFERENCES

- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
 - 1. American Iron and Steel Institute (AISI),
 - 2. American National Safety Institute (ANSI),
 - 3. American Society of Mechanical Engineers (ASME),
 - 4. American Society of Testing and Materials (ASTM),
 - 5. National Electrical Manufacturer's Association (NEMA),
 - 6. Occupational Safety and Health Administration (OHSA),
 - 7. Underwriters Laboratories (UL),

8. Entertainment Services and Technology Association (ESTA)
9. Entertainment Technicians Certification Program (ETCP)

1.5 DESCRIPTIONS AND REQUIREMENTS

- A. The following is intended to further describe the Work and clarify design intent and is not an exhaustive description of the Theatrical Rigging Systems. Refer to the Theatre Rigging Systems (TR Series) drawings for further information relating to this Section.
- B. This specification is performance-based and requires the Contractor to provide all subsequent design and engineering for the system described and as required for proper installation and safe operation.
- C. General Requirements
 1. Each rigging component must include the quantity of wire rope lift lines, trim chains, compression sleeve fittings, pipe or truss batten sections, and all necessary hardware for a fully operable rigging system.
 2. Draperies shall be constructed of professional grade fabric intended for use as stage curtains. All draperies will be certified as flame retardant as a result of either their inherent characteristics or chemical treatment in accordance with the AHJ.

1.6 RESPONSIBILITY AND RELATED WORK

- A. The drawings included with this specification convey general system concepts. The plans do not show complete and accurate building details. The Installer is responsible for making the field measurements necessary to establish exact locations, relationships, load capacities necessary for the installation of these systems. Coordinate the work with the General, Electrical and other related contractors as stated in Part 1.4, and the scheduled work of other trades.
- B. Conduit infrastructure system, including wire for AC Power and grounding for the Theatre Rigging Systems, shall be provided as part of the contract. Coordination between different disciplines is required to achieve a proper conduit system installation and power provisions for Theatre Rigging Systems. The electrical installation shall be in accordance with division 26 and the National Electric Code.
- C. Verify the requirements and integrate components of the theatre lighting power and control system mounted to rigging hardware.
- D. Supply accessories and minor equipment items needed for a complete system, even if not specifically mentioned in these Specifications or on the associated Drawings, without claim for additional payment.
- E. Notwithstanding any detailed information in the Contract Documents, it is the responsibility of the Theatrical Rigging Systems Installer to supply systems in full working order. Notify the Architect of any discrepancies in part numbers or quantities before bid. Failing to provide such notification requires Theatrical Rigging Systems Installer to supply items and quantities according to the intent of the Specifications and associated Drawings without claim for additional payment.
- F. Obtain all permits necessary for the execution of any work pertaining to the installation, or any operation by the Owner including any associated charges or fees.
- G. Execute all work in accordance with all Standard Authorities listed above, and all applicable State and Local codes, ordinances, and regulations. If a conflict develops between the contract document and the appropriate codes and is reported to the Architect prior to bid opening, the

Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

1.7 QUALITY ASSURANCE

- A. Theatrical Rigging Installer's Qualifications: Firm experienced in the provision of systems similar in complexity to those required for this project; and meet the following:
1. No less than five years' experience with equipment and systems of the specified types under the same business name.
 2. Experience with at least five projects of comparable scale within the last two years.
 3. Employ only fully trained stage riggers and mechanics for the erection of the stage equipment.
 4. All theatrical rigging activity shall be supervised by an ETCP certified theatre rigger.
 5. The stage riggers will be completely familiar with the type of equipment to be installed. A competent and knowledgeable Job Superintendent will be on the job at all times when work is in progress.
 6. Maintain a fully staffed and equipped service facility.
 7. Contractor shall attend pre-installation meetings to coordinate with other trades as required.

1.8 PRE-INSTALLATION SUBMITTALS:

- A. The submittal information required by the specification is to be presented complete and as submissions noted below. Submittals are a crucial and integral part of the construction process; as such the Owner's consultant will not recommend payment to the installer above 25% of the scheduled value of this work until all submittal information has been approved. Cost for the Owner's consultant to review secondary and re-submittals due to the Installer's failure to include all required submittal information, or rejection of incomplete or improperly prepared submittal information will be the responsibility of the Installer. The cost shall be based on the hourly rates of the Architect and consultants as published in their current professional fees schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost-plus ten percent (10%).
- B. Project Submittal Part 1:
1. Provide for approval not later than thirty (30) days after issuance of Notice to Proceed and prior to commencement of Work:
 - a. Section 1: A complete schedule of submittals.
 - b. Section 2: A chronological schedule of Work in bar chart form. Revise and resubmit schedule as required to reflect construction progress.
- C. Project Submittal Part 2:
1. Provide for approval no later than sixty (60) days after issuance of notice to proceed and in accordance with previously submitted submittal schedule.
 - a. Section 1: Complete list of products to be incorporated within the Work.
 - b. Section 2: Manufacturer's data sheets for each product. Provide original manufacturer's data sheets in order as they appear in the specification. These data sheets are submitted for each product in sufficient detail to facilitate proper evaluation to the products suitability for incorporation within the Work.
 - c. Section 3: Fabric Samples. Submit a sample book of each fabric specified, containing manufacturer's standard colors available in the quality of fabric specified for the Owner's selection and approval of color. More than one color may be selected. After selection, upon request, submit one square foot sample of each fabric in each color for final review.

- d. Section 4: Submit Material Safety Data Sheets (MSDS) for each potentially hazardous material prior to use. Include information pertaining to the hazardous material with the MSDS.
2. Drawings:
 - a. Provide computer software generated drawings using standard industry graphic standards. Hand or poorly drawn documents will not be accepted. All drawings shall be created on a computer aided drawing (CAD) system compatible with AutoCAD release 2010. Electronic files of theatrical rigging contract documents shall not be distributed for use in generating submittal documents with the exception of architectural backgrounds.
 - b. Drawings depicting attachment of equipment to structure or mechanical assemblies that support overhead loads must show the work has been reviewed and sealed by a structural engineer licensed to practice in the State of Texas.
 - c. Installation Drawings. Provide drawings showing special details depicting methods and means specific to each product and each product manufacturer's recommended installation methods and means. Provide assembly and attachment for each product. Drawings should be reviewed and sealed by a structural engineer licensed to practice in the State of Texas.
 - d. Schematic Drawings. Provide drawings detailing inter-component and intra-component, on Theatrical Rigging Installer assembled components or fabricated products.
 - e. Conduit and Electrical Drawings. If the system incorporates an electrical or electronic system of any type, provide floor plan drawings, including all walls, doors and rooms, showing exact power requirements and conduit routing for each system with the location of all junction boxes, terminations, etc.
 - f. Equipment Drawings. Provide equipment mounting and location details including necessary physical dimensions, clearances, load limits, etc.
 - g. Software diagrams showing the hierarchical structure of operator screens and functions with sample screen shots.
 - h. Floor plan and Section Drawings. Provide drawings showing the exact location of all installed equipment on floor plans and/or sections such as guide wires or tracks, loft blocks, battens, etc.
 - i. Custom Enclosures and Millwork Drawings. If custom enclosures or millwork is required, provide full fabrication detail drawings indicating size, material, finish and openings for equipment.
 - j. Fabricated Plates, Panels, or Signage Drawings. If plates, panels, or signage is required, provide complete drawings depicting dimensioned locations of components, component types, engraving or printing information, plate material and color, and bill of material.
 - k. Labeling Drawing. Provide representative equipment labeling scheme of locking rail, loading rail, etc.
 - l. General Detail Drawings. Provide detail drawings depicting any unique installation methods specific to each product.
 - m. Any other pertinent data generated which is necessary to provide the Work.
- D. Submittal Format:
 1. Electronic submission of submittals is encouraged. Where non- electronic submittals shall be bound in a three-ring D style binder sized for 150% of the material with a maximum size being a three inch spine. Use multiple volumes if necessary.
 2. Provide each submittal with a unique number and be numbered in consecutive order.
 3. Provide each submittal binder with a cover and a spine reflecting the project title and submittal number.
 4. Provide each submittal with a complete table of contents with the following information:
 - a. Project title and number.

- b. Submittal number. In the case of a re-submittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and be numbered in consecutive order.
 - c. Date of submission.
 - d. Referenced addendum or change-order number as applicable.
 - e. Referenced specification Section, Part, Article, Paragraph and page number or drawing reference as applicable.
 - f. Index Product Data sheets by manufacturer and model or part number.
5. Separate major grouping with labeled binder tabs.
 6. Arrange product data list in alpha-numeric order when applicable followed by unspecified product arrange by manufacturer and model or part number. Follow list by manufacturer's data sheets, arranged in the same order. If a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
 7. Drawings executed at an appropriate scale, not smaller than $\frac{1}{8}$ " = 1'-0" for conduit/floor plans, $\frac{1}{4}$ " = 1'-0" for equipment layouts, and $\frac{1}{2}$ " = 1'-0" for mounting details and plate/panel details.
- E. Submittal Copies:
1. These requirements represent minimum project requirements; a project's general conditions may require additional copies for project distribution.
 2. Electronic submission of submittals is encouraged. Where non-electronic documents are required, submit all documents electronically in PDF format.
 3. Where hardcopy submittals may be required,
 - a. Submit (3) bound prints of all drawings.
 4. Submit (3) copies of bound materials (e.g. product data.)
 - a. Submit (2) sets of any product or sample finishes as required within this specification.
- F. Resubmission Requirements:
1. Make any requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
 2. Indicate any changes that have been made other than those requested.
- G. Approval of Submittals: The submittal information will be reviewed by the general contractor, owner, Architects, engineers, and consultant. Each submittal package will be returned, stamped as follows:
1. "No Exceptions Taken" proceed with construction, all job site coordination will be at the direction of the general contractor.
 2. "Make Corrections Noted: No Resubmission Required" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made before construction can begin.
 3. "Make Corrections Noted: Submit Corrected Copy" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made in writing and returned to the consultant before construction can begin.
 4. "REJECTED, Submit Specified Item" a specified item in the submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
 5. "REJECTED, Revise and Re-submit" submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
 6. "No Review Action Required" all information provided was for information or coordination purposes only. Review is not required.

1.9 PROJECT RECORD MANUAL

- A. Submit three bound original sets (this is a minimum of two for the Owner and one for the Architect's consultant; additional copies may be required by the project's general conditions) after substantial completion and prior to final inspection.

- B. The Project Record Manual shall be segregated into three separate bindings as follows:
 1. Operations Manual:
 - a. Product Data: Product actually incorporated within the Work:
 - 1) Manufacturer's data for each type of product conforming to the scheme above. The list shall include manufacturer's serial numbers.
 - 2) Owner/Instruction Manual for each product.
 - 3) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item.
 - 4) Manufacturer's wiring diagram for each type of product actually incorporated.
 - 5) Separately bound list by manufacturer and model or part number of all products incorporated within the Work arranged in alphanumeric order.
 - b. Record drawings: Final rendition of that specified depicting what is actually incorporated within the Work. Provide one (1) full size set and one (1) DVD-ROM containing all CAD generated drawings prepared in conjunction with this project. Drawing files to be in AutoCAD Release 2010 DWG format.
 - c. Test Reports: Recorded findings of testing specification of this specification.
 - d. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
 - 1) This procedure should describe the operation of all system capabilities.
 - 2) Assume the intended reader of the manual to be technically experienced but unfamiliar with the components and the facility.
 2. Service & Maintenance Manual:
 - a. Provide an original copy of the service manual on every piece of equipment for which the manufacturer offers a service manual. Arrange manuals in the same order as the operations manual.
 - b. Manufacturer's maintenance and care instructions.
 - c. Maintenance Instructions, including maintenance phone number(s) and hours; maintenance schedule; description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
 - d. Replacement parts list of all minor equipment such as fuses, lamps, connectors, knobs, etc.
 3. Warranty Manual:
 - a. Manufacturer's warranty statements on each product.
 - b. Date of substantial completion and ending dates for warranties for each group of products.
 - c. Software registration and licenses.

- C. Include any other pertinent data generated during the Project or required for future service.

- D. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Ship product in its original container, to prevent damaging or entrance of foreign matter.

- B. Handling and shipping in accordance with manufacturer's recommendation.

- C. Provide protective covering during construction, to prevent damaging or entrance of foreign matter.

- D. Replace at no expense to Owner, product damaged during storage, handling or the course of construction.

1.11 PROJECT CONDITIONS

- A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The Drawings diagrammatically show arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the work may be installed.

1.12 FINAL INSPECTION AND TESTING

- A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final inspection and test will be observed by the Architect and/or Architect's Consultant no earlier than two weeks after receipt of the written results.
- B. Provide a minimum of one (1) person for inspection and two (2) persons for testing familiar with aspects of the System to assist the Owner.
- C. The process of testing the System may necessitate moving and adjusting certain components such as counterweights on arbors, adjustment of drapery tracks, etc.
- D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
- E. The following procedures will be performed on each System:
 - 1. Inspection of the methods and means employed to incorporate the System within the facility.
 - 2. Verification of proper operation, from controlling devices to controlled devices.
 - 3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each setting, and appropriately record these settings within the Record Documents.
 - 4. Other tests on equipment or systems deemed appropriate.
- F. In the event the need for further adjustment or work becomes evident during testing, the Theatrical Rigging Installer is to continue work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the inspection and testing period is required, the contract price will be reduced for the additional time and expenses of the Owner, at the standard rate in effect at that time.
- G. Rigging system installer shall return to the jobsite six months after acceptance to inspect the rigging hardware and attachments, curtain tracks, curtains, and battens.

1.13 WARRANTY

- A. Warrant labor and product for two (2) years following the date of substantial completion to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind,

quality, function, and characteristics. Repair or replace defects occurring in labor or product within the Warranty period without charge. Any cost required to complete this warranty repair is the responsibility of the contractor.

- B. This warranty is in addition to any specific warranties issued by manufacturers for greater periods of time.
- C. Within the warranty period, answer service calls within eight hours, and correct the deficiency within twenty-four hours.
- D. This warranty will include two (2) ANSI-compliant annual inspections. The inspection will be a level one inspection for manually operated systems and a level two inspection for all motorized equipment. The first will occur 1-year after the project's substantial completion, and the second shall occur before the end of the two (2) year warranty. The Contractor shall provide the inspections at no cost to the Owner and at an agreed-upon time and date. The Contractor shall provide a full report with deficiencies or findings. All repairs covered by applicable warranties will be completed.

1.14 INSTRUCTION OF OWNER PERSONNEL

- A. After final completion, provide instruction to Owner and/or the Owner's designated personnel on the use, operation, maintenance and care of the System.
 - 1. Develop training course based on the use of the System and manufacturers' recommendation. Provide (8) hours of training. The training period shall be divided into two segments and shall be scheduled at least two weeks apart. All training shall be scheduled at the convenience of the owner and designated personnel.
 - 2. Submit an outline of the course with sample instructional aids for approval (30) days prior to scheduled instruction sessions.
 - 3. If a representative of the manufacturer is used in the instructional course, the Theatrical Rigging Systems Installer must be present throughout the extent of the course and ensure that the representative abides by the requirements set forth in these specifications.
- B. Rigging system installer shall be present at the first two (2) uses of the facility.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Model name and number for manufacturers included in this specification are listed to establish a standard of product quality.
- B. Substitution of specified products with other qualified manufacturers and products will be considered providing:
 - 1. Proper substitution procedures outline under Division 1 is adhered to.
 - 2. A request for substitution of each specific product must be made in writing by a bidding Contractor not less than ten (10) business days prior to bid for written approval of the Architect.
 - 3. Sufficient data of the products is presented for prior approval including technical data, manufacturer's specifications, samples, and, if requested, results of independent testing laboratory tests.
 - 4. Written permission is obtained for the substitution from the Owner or Owner's Representative.

- C. If proposed system includes equipment other than specified model numbers, submit a list of major items and their quantities, with a one-line schematic diagram for review. Include a list of previously installed projects using proposed equipment that are similar in nature to specified System.
- D. Provide product not specifically specified commensurate with the quality and standards established by the specified product.

2.2 GENERAL

- A. Products shall be new, free from defects and listed by UL when an applicable UL Standard exists. Provide product of a given type from one manufacturer.
- B. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturers' published specifications.

2.3 CONTACTS

- A. Listed below is contact information for Manufacturers of rigging components approved to provide equipment on this project. The below is not listed any preference or preferred order:
- B. Automatic Devices Company
 - 1. 2121 S. 12th Street, Allentown, PA. 18103
 - 2. Telephone: (610) 797-6000
 - 3. Approved to supply curtain track and curtain motors.
- C. Wenger (JR Clancy)
 - 1. 7041 Interstate Island Road, Syracuse, NY 13209
 - 2. Telephone: (315) 451-3440
 - 3. Approved to supply stage rigging components, motorized hoists, hoist control, fire safety curtains and accessories, beam clamps, and associated hardware.
- D. Crosby Group, Inc.
 - 1. P.O. Box 3128, Tulsa, Oklahoma 74101
 - 2. Telephone: (918) 834-4611
 - 3. Approved to supply rigging hardware including chain, cable clips, cable, and anchor shackles.
- E. Electronic Theatre Controls
 - 1. 3031 Pleasant View Rd, PO Box 620979, Middleton WI 53562
 - 2. Telephone (608) 831-4116
 - 3. Approved to supply rigging hoists and controls.
- F. H&H Specialties
 - 1. P.O. Box 9327, South El Monte, Calif. 91733
 - 2. Telephone: (213) 283-3562
 - 3. Approved to supply stage rigging loft/head blocks, curtain tracks, and curtain motors.
- G. K&M Fabrics
 - 1. 2 Waco Street, Greenville, South Carolina 29611
 - 2. Telephone: (800) 845-1896
 - 3. Approved to supply curtain fabric.
- H. J.B. Martin

1. 445 rue St-Jean-sur-Richelieu, Quebec, Canada J3B 2M1
2. Telephone: (514) 346-6853
3. Approved to supply curtain fabric

I. Rud Stage Rigging

1. 1300 Stoney Point Road SW, Cedar Rapids, Iowa 52408
2. Telephone: (800) 553-7993
3. Approved to supply rigging hardware including chain and shackles.

J. Safety Technology International, Inc.

1. 2306 Airport Road, Waterford, MI 48327
2. Telephone: (248) 673 9898
3. Approved to supply polycarbonate device covers.

K. Texas Scenic Company

1. 8053 Potranco Rd, San Antonio, Texas 78251
2. Telephone: (210) 684-0091
3. Approved to supply rigging Hoists and controls, rigging hardware, stage drapery, fire curtain systems.

L. Ver Sales, Inc.

1. 2509 N. Naomi Street, Burbank, Ca. 91504
2. Telephone: (818) 567-3000
3. Approved to provide rigging hardware including chain and beam clamps.

M. IWeiss

1. 815 Fairview Avenue Suite 10, Fairview, New Jersey, 07022
2. Telephone: (201) 402-6500
3. Approved to supply rigging hardware, stage drapery, stage rigging loft/head blocks, and curtain tracks.

N. Protech Theatrical Services

1. 3431 N Bruce Street. North Las Vegas, Nevada 89030
2. Telephone: (702) 639-0290
3. Approved to supply rigging hardware. stage drapery, stage rigging loft/head blocks, and curtain tracks.

2.4 COMPLETED SYSTEM

A. General

1. All installation of stage rigging equipment shall be completed utilizing new materials, free from flaws and rust, and in good working order. The jobsite shall be cleaned of all packing materials, lubricants, metal shaving, miscellaneous hardware, and components not used in the installation.
2. All dimensions are to be field verified. Location and attachment of hardware and size of components shall be confirmed by the stage rigging installer.
3. All electrical power, outlets, related systems, and structural elements required to make the system fully functional are the responsibility of the contractor.
4. If components and hardware are not specifically specified or called out, it is the responsibility of the contractor to provide those components in order to provide a fully operational theatre rigging system.

2.5 RIGGING HARDWARE

A. Batten Assembly

1. Pipe battens shall be constructed of new ASTM A53/A 1-1/2" nominal schedule 40 plain end steel pipe.
 2. Battens exceeding one standard pipe length will be joined using an internal splicing sleeve. Splices must provide the same overall capacity, deflection, and strength to the pipe battens as an un-spliced span. Threaded couplers are not permitted.
 - a. Splice sleeves shall be a minimum of 18" in length with a minimum of 9" extending into each pipe batten.
 - b. Sleeves will be machined to a diameter that will create a snug fit within the pipe battens.
 - c. Splicing sleeves will be fastened to the pipe batten with pins or 3/8" diameter bolts. Locate at least two fasteners on each side of splice joint; alternate direction of fasteners at right angles to one another across the diameter of the pipe.
 3. Any fasteners used on pipe battens must meet SAE grade 5, and be equipped with self-locking nuts.
 4. Cover the end of each batten with a yellow or white closed end, soft vinyl safety cap at least 4 inches in length. Cap shall display linesets maximum capacity, and lineset number.
- B. Batten Connections
1. Wire rope lift lines shall terminate directly to trim chains constructed of NACM chain certified by their manufacturer as suitable for the intended purpose.
 2. Chain shall be 1/4" diameter or larger, and of sufficient length to wrap one and one-half times around the pipe batten and return to the eye of the wire rope lift line.
 3. One chain end shall be terminated directly to the wire-rope eye, the other end secured with a forged screw pin anchor shackle rated for the intended purpose. The screw pin shall be moused or seized to ensure the pin will not release.
 4. Alternative designs for batten connection and trimming methods shall require approval as part of the submittal process.
 5. Where a pipe clamp may be required on a batten, a wrap-around type clamp shall be provided. This clamp shall be secured to the pipe using SAE 5 grade bolts, washers, and self-locking nuts.
 6. Acceptable products:
 - a. Clancy Alpha Chain
 - b. 7 mm (0.275") Grade 63 alloy chain
- C. Wire Rope Lift Lines
1. Provide lift lines and fittings appropriate for supporting the load requirements.
 2. For utility and drapery sets:
 - a. Lift lines shall be a minimum of 3/16" diameter 7 X 19 construction, galvanized aircraft cable with a breaking strength of 4200 lbs.
 3. For shell and stage electric sets:
 - a. Lift lines shall be a minimum of 1/4" diameter 7 X 19 construction, galvanized aircraft cable with a breaking strength of 7000 lbs.
 4. All wire rope must be new; damaged or deformed cable may not be used.
 5. Exposed ends of wire rope shall be cut cleanly, then seized.
- D. Wire Rope Termination
1. To connecting hardware, form eyes around an appropriately sized thimble using copper Nicopress® compression sleeves.
 2. To cable drums: terminate the wire rope on the inside of the lifting drum using a Nicopress® compression stop sleeve.
 3. Supply and install compression sleeves or clips in size and quantity per guidelines set forth in the Wire Rope User's Manual, by its manufacturer's specifications, and in accordance with industry guidelines.

- E. Rigging Accessories:
 - 1. In certain instances special component parts, such as sheaves, idler blocks, extra lines, etc., will be necessary in order to provide a fully operable system. Where such requirements are necessary, furnish, install, and adjust these components comparable to the quality of the products listed in these specifications.
 - 2. Acceptable manufacturers:
 - a. H&H Specialties
 - b. JR Clancy
 - c. Crosby
 - d. Sapsis Rigging

2.6 FIXED BATTENS AND LIGHTING PIPES

- A. Provide pipe assemblies attached to structure as described in the drawings.
- B. Assemblies shall be constructed of new ASTM A53/A 1-½" nominal schedule 40 plain end steel pipe.
- C. Pipe Grid Configuration
 - 1. Cross-over Clamps
 - a. Intersecting pipes shall be joined with specialty hardware to clamp, join, and support pipe-grid segments. Clamps shall have a recommended working load of at least 1,500 lbs. U-bolts are not acceptable.
 - b. Acceptable product:
 - 1) JR Clancy Cross-Over Clamp
 - 2) Approved equal.
 - 2. Each pipe shall terminate just off the wall. Internally sleeved wall plates shall securely brace the grid against the wall once it is in place. Supply sufficient braces to prevent lateral movement of the pipe grid.
 - 3. Suspension
 - a. The grid shall be rigidly hung from the overhead steel structures on centers at nominal 6 ft. x 6 ft. intervals, and not exceeding 8 feet in either direction. Suspension methods shall be either:
 - 1) Pipe-hangers suitable to the intended load and SAE grade 5 threaded rod, or
 - 2) ¼-inch, 7x19 galvanized utility cable ending in 6 inches x 3/8 inch (152.4 mm x 9.5 mm) forged turnbuckles attached to pipe clamps.

2.7 STAGE DRAPERIES TRACKS

- A. Straight Draw Curtain Tracks
 - 1. Provide and install the curtain tracks as located and configured on the drawings.
 - 2. Track shall be constructed of 14 gauge galvanized steel, roll formed to a 2-5/8" W X 2-3/4" H channel with continuous slot in bottom. Provide un-spliced lengths up to 26' in length.
 - 3. Track must mount to pipe battens on maximum 5'-0" centers with two-piece hangers formed from 11 gauge steel.
 - 4. Provide a minimum of 2'-0" overlap in the center. Separate tracks at center with two overlap clamps.
 - 5. Install carrier stops with at each end of track.
 - 6. Provide single carriers, spaced 12" on center, constructed of (2) nylon-tired ball bearing wheels fastened parallel to carrier body. Supply carriers with heavy duty hook, swivel eye, and trim chain for attachment of drapes. Install neoprene bumper between each carrier to reduce noise.
 - 7. Provide master carriers with 4-wheel nylon-tired ball bearing assemblies with bodies formed from 11 gauge steel. Connect to operating line with two formed steel cord clamps

- attached to each body. Supply each master carrier with two heavy duty hooks, swivel eyes, and trim chains for attachment of leading edge of drape.
8. Single and double end pulleys will clamp securely to the underside of the track channel and will be equipped with 6" diameter Nylatron GS sheaves grooved for up to ½" hand line. Install (2) ⅝" sealed precision ball bearings in each sheave. Lock shaft to side plate on head end with ⅜" keeper pin to prevent rotation and install fine threaded nylon insert lock nut.
 9. Dead end pulley shall be mounted at 45 degrees from the traveler tracks to reduce clearance required for pulley between pipe battens.
 10. Provide a sand bag tension pulley for operation of hand line of the mid-stage traveler. Provide adequate quantity of sand for proper hand line operation.
 11. Hand line shall be ½" diameter, stretch resistant rope with spun polyester outer jacket double braided over solid polyester core.
 12. Acceptable products:
 - a. H&H Specialties series 400
 - b. ADC series 280
- B. Walk-along Curtain Tracks
1. Provide materials and the labor to install the curtain tracks as located and configured on the drawings.
 2. Track shall be made of 6063-T5 aluminum, extruded into 2-½" I-beam with 1" wide top, intermediate and bottom flanges. Provide un-spliced lengths up to 24' in length.
 3. Track must mount to pipe battens on maximum 5'-0" centers with two-piece hangers formed from 11 gauge steel hangers.
 4. Provide single carriers, spaced 12" on center, constructed of (2) Delrin wheels fastened parallel to formed steel carrier body. Supply carriers with swivel hook for attachment of drapes. Install Nylatron wear strips at contact points to act as a bumper between each carrier to reduce friction. Provide neoprene bumpers between each carrier to reduce noise.
 5. Provide walk along handles attached to the master carriers for operation of the curtain.
 6. Provide end stops at each end of the track.
 7. Ensure that all steel components are zinc plated for corrosion resistance.
 8. Provide all track and associated hardware factory coated BLACK
 9. Acceptable products:
 - a. H&H Specialties series 300
 - b. ADC series 140

2.8 CHAIN HOISTS:

- A. Provide motorized chain hoists for use in hoisting temporary end-user equipment to the tension wire grid level.
- B. Hoists shall:
 1. Operate at a nominal 120VAC single phase.
 2. Have a maximum travel of 60ft.
 3. Operate at a fixed speed of nominal 16 ft/min.
- C. Hoists shall consist of an integrated motor, gearbox, and brake mounted in a heavy-duty case sealed from dirt and other contaminants.
- D. The hoist brake shall be direct-acting electrically-released and must provide fail safe breaking in the event of a power failure.

- E. Each winch shall have an integrated, field-adjustable limit switch assembly coupled with the drive train. Switches shall sense normal and emergency over-travel positions at both ends of the range of operation.
- F. Hoists shall have built in load monitoring and load limiting.
- G. Lifting chain shall be of a specialty alloy sized for the anticipated loads and designed for overhead lifting. As load is lifted, loose chain shall feed into a suitable receptacle attached to the hoist for storage.
- H. Motor case and chain shall be supplied with self-locking hooks.
- I. Provide with direct plug-in pendant with UP/DOWN control buttons and ON/OFF buttons and indicators.
- J. Provide (5) 1/2-ton capacity motor
 - 1. Provide (3) units with beam trolley to match beam and load. Refer to beams in scenic shop space for size.
- K. Acceptable product: CM ProStar

2.9 PORTABLE RIGGING ACCESSORIES

- A. Provide the following equipment into the project.
 - 1. Temporary Lighting Positions
 - a. Pipe battens shall conform to Part 2, Section 2.5. A, of this specification and be constructed of new ASTM A53/A 1-1/2" nominal schedule 40 plain end steel pipe, free of burrs and sharp edges, primed and painted with a durable black finish.
 - 1) Provide (12) 10'-0" long
 - 2) Provide (12) 12'-0" long
 - 2. Temporary Rigging Rope
 - a. 5/8" Solid Braid Utility Rope
 - 1) (1) 600ft spool of 5/8" diameter, 2,400 lbs tensile strength utility rope, black.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.
- B. Mount equipment and enclosures plumb and level.
- C. Permanently installed equipment to be firmly and safely held in place in accordance with specified safety factors and Federal and State codes and regulations.
- D. Work shall be completed within industry guidelines, including, Entertainment Services and Technology Association (ESTA), OSHA, National Electric Code, American National Standards Institute, American Society for Testing and Materials, American Institute of Steel Construction, National Fire Protection Association, National Electrical Manufacturers Association, plus any or all local, governmental, or other applicable codes.
- E. Where dimensions and loading capacities have been omitted from this specification, they are to be determined by the Contractor, in accordance with the accepted industry standards and

guidelines in this section. In no way will the theatre rigging contractor be relieved of primary responsibility to provide a safe, fully functional system.

- F. The mechanical fabrication and workmanship will incorporate the best practices for good fit and finish. There will not be any burrs or sharp edges to cause a hazard, nor will there be any sharp corners accessible to personnel.
- G. All equipment will be installed based on the manufacturer's recommendations and for the use intended by the manufacturer.
- H. All shop and field welding will meet the qualifications of the AISC manual and will be without spatter or other evidence of poor practices.
- I. All finishes which are disturbed during shipping and installation will be touched up to match the original.
- J. Materials will conform to the following ASTM standard specifications:
 - 1. A-36 structural steel
 - 2. A-36 steel plates and bars
 - 3. A-47 malleable iron casting
 - 4. A-48 gray iron casting
 - 5. A-53 welded and seamless steel pipe
 - 6. A-120 black and hot dipped zinc-coated steel pipe
- K. In order to establish minimum standards of safety, the following factors will be used:
 - 1. cables and fittings provide a minimum 8:1 design factor
 - 2. cable bending ratio is 30 times the cable diameter
 - 3. nuts and bolts use minimum SAE grade 5 (ASTM rating A-449)
 - 4. thread pressure of
 - a. 500 lb. for cast iron
 - b. 1000 lb. for steel
 - c. 1500 lb. for Nylatron
 - 5. steel designed to 1/5 of yield
 - 6. bearings are rated for two times the required load operating at full speed for 2000 hours.

3.2 INSTALLATION OF MOTORIZED RIGGING SYSTEM

- A. All wire rope components will be installed so as to prevent abrasion or rubbing of the wire rope against any part of the building construction or other equipment.
- B. Pulleys and sheaves will be aligned as to provide a maximum fleet angle of 1.5 degrees. Mule blocks, cable rollers, guides, and sag bars will be installed as required to provide proper alignment.

3.3 INSTALLATION OF STAGE DRAPES AND TRACKS

- A. Install all tracks and hardware according to manufacturer's recommendations.
- B. Stage draperies shall be installed near the end of the installation when chances of damage from other work are reduced. Stage area shall be broom clean with no further construction taking place prior to installation.
- C. After hanging stage draperies, thoroughly brush to remove dust, visible dirt, loose threads, loose fabric lint, etc. Wrinkles will be allowed to fall out naturally.

3.4 LABELING OF EQUIPMENT

- A. Mark and label each batten with its set number, load/arbor capacity, stage centerline, and lift line locations with appropriate paint.
- B. Provide labels clearly indicating date of manufacture, cloth type, manufacturer's name and address, size (width and height using 3/4" minimum lettering), and Owner's designated inventory number (to be coordinated with Owner) will be sewn into the back (in most cases, upstage) side of the upper hem at both ends of each drape panel.

3.5 CONTRACTOR COMMISSIONING

- A. Prior to energizing or testing the System ensure the following:
 - 1. Products are installed in proper and safe manner according to manufacturer's instructions.
 - 2. Dusts, debris, solder splatter, etc. is removed.
 - 3. Labeling has been provided.
 - 4. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
 - 5. Products are neat, clean and unmarred and parts securely attached.
 - 6. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded. Job site shall be left broom clean.
- B. Provide two portable VHF or UHF business band radios for use during acceptance testing with transmission range sufficient to cover entire project.
 - 1. Include rechargeable batteries and re-charger along with "holster" for wearing on belt.
 - 2. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

END OF SECTION 11 61 33

SECTION 11 61 43 - STAGE DRAPERIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This specification describes the manufacture and installation of stage curtains in the St. Phillip's Watson Fine Arts Center Black Box addition.

1.2 RELATED DOCUMENTS

- A. Theatre Rigging Systems Drawings ("TR" Series) and general provisions of the contract including general and supplementary conditions and Division 1 Specification sections apply to this section.

1.3 SECTION INCLUDES

- A. Project instructions for the Contractor and System description details.
- B. System product descriptions.
- C. Project completion instructions for the Contractor.

1.4 RESPONSIBILITY AND RELATED WORK

- A. Coordination, supply, installation, shipping, storage, inspection, commissioning, testing, instruction and warranties of the Stage Draperies.
- B. Plant, materials, equipment, transport and labor necessary to accomplish this and have a complete and fully functioning System.
- C. Also includes:
 - 1. Required licenses and permits including payment of charges and fees.
 - 2. Verification of dimensions and conditions at the job site.
 - 3. Provision of submissions.
 - 4. Installation in accordance with the Contract Documents, Manufacturer's recommendation, and in conformity with applicable codes and authority having jurisdiction.
 - 5. Extension of electrical service, including ground, to equipment locations.
- D. The drawings included with this specification convey general system concepts. Where the plans do not show complete and accurate building details, the Contractor is responsible for making field measurements necessary to establish exact locations, relationships, and load capacities necessary for the installation of these systems.
- E. Coordinate the work with the related documents and the scheduled work of other trades.
- F. Supply accessories and minor equipment items needed for a complete and fully operational system, even if not specifically mentioned in these Specifications or on the associated Drawings, without claim for additional payment.

- G. Notify the Architect of any discrepancies in part numbers or quantities before bid. Failing to provide such notification requires the Contractor to supply items and quantities according to the intent of the Specifications and associated Drawings without claim for additional payment.
- H. Specifications and drawings are complementary. Work called for by one is binding as if called for by both. Any discrepancies between specifications and drawings shall be brought to the attention of the Architect for clarification during the bidding period. No allowance shall subsequently be made to the Contractor by reason of their failure to have brought said discrepancies to the attention of the Architect.
- I. Execute all work in accordance with all Standard Authorities listed above, and all applicable State and Local codes, ordinances, and regulations.
- J. If a conflict develops between the Contract Documents and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.
- K. Flame proofing and Documentation of Drapery Fabrics:
 - 1. Provide inherently flame retardant or chemically flame proofed draperies. Chemical flame proofing formula and process must adhere to Bureau of Standards U.S. Department of Commerce. Once fabric is processed, it will pass such tests as are required by the Fire Marshall of the local fire department, the Owner, and any other authority having jurisdiction.
 - 2. A certificate for each drape is required to be provided to the Owner. This certificate clearly indicates: the name of the Stage Drapery (sub) Supplier, the name and color of the fabric, the name of the Company providing flame proofing treatment, date of the treatment, the date of re-treatment required, the name of the chemical and method used, the signature of an officer or approved representative of the Company providing flame proofing treatment, and the signature of an officer of the company installing the draperies. Official seal(s) and signature(s) of a notary public is required for the both signatures.
 - 3. Labels clearly indicating date of manufacture, cloth type, manufacturer's name and address, size (width and height using 3/4" minimum lettering), and Owner's designated inventory number (to be coordinated with Owner) will be sewn into the back (in most cases, upstage) side of the upper hem at both ends of each drape panel.

1.5 REFERENCES

- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
 - 1. National Fire Protection Association (NFPA)
 - 2. American National Standards Institute (ANSI)
 - 3. American Society of Testing and Materials (ASTM)
 - 4. Occupational Safety and Health Administration (OSHA)
 - 5. Underwriters Laboratories (UL)
 - 6. Entertainment Services and Technology Association (ESTA)
 - 7. Entertainment Technicians Certification Program (ETCP)

1.6 DESCRIPTIONS AND REQUIREMENTS

- A. Black Box
 - 1. Drapery for the Black Box shall consist of:
 - a. A series of black masking legs suspended from walk-along tracks beneath the pipe-grid system as scheduled and located on the drawings. Additional loose panels will be provided for space flexibility.

- B. Accessories
 - 1. Provide wheeled hampers with lids for storage of spare/loose curtains.

- C. General Requirements
 - 1. It is the responsibility of the stage curtain provider to ensure the proper size and fit of the drapery within the facility.
 - 2. All drapery shall be sized and verified based on field measurements prior to fabrication.

1.7 QUALITY ASSURANCE

- A. Contractor's Qualifications: Firm experienced in the provision of systems similar in complexity to those required for this project; and meet the following:
 - 1. No less than five (5) years of experience with equipment and systems of the specified types.
 - 2. Experience with at least five (5) comparable scale projects within the last two (2) years.
 - 3. Employ only fully trained stage riggers and mechanics for the erection of the stage equipment.
 - 4. An ETCP certified theatre rigger shall supervise all rigging installation.
 - 5. The stage riggers will be completely familiar with the type of equipment to be installed. A competent and knowledgeable Job Superintendent will be on the job at all times when Work is in progress.
 - 6. Maintain a fully staffed and equipped service facility.
 - 7. At the request of the Architect, demonstrate that:
 - a. Adequate plant and equipment is available to complete the work.
 - b. Adequate staff with commensurate technical experience is available.

1.8 SUBMITTALS:

- A. Provide submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures section unless otherwise indicated.

- B. The submittal information required by the specification is to be presented complete and as submissions noted below. Submittals are a crucial and integral part of the construction process; as such the Owner's consultant will not recommend payment to the Contractor above 25% of the scheduled value of this work until all submittal information has been approved.

- C. Submittals must be original work produced by the firm responsible for performing the work defined in this specification. Scanning, photographic copying, materially copying, or any other reproducing the contents of the drawings or specifications contained within the Contract Documents will be marked as unacceptable and not reviewed for any content. No claim shall be made for delay, undue burden, or additional costs for the effort to produce shop drawings, schedules, and equipment lists addressing this specification or the overall project manual.

- D. Project Submittal Part 1:
 - 1. Provide for approval not later than thirty (30) days after issuance of Notice to Proceed and prior to commencement of Work:
 - a. Section 1: A complete schedule of submittals.
 - b. Section 2: A chronological schedule of Work in bar chart form. Revise and resubmit schedule as required to reflect construction progress.

- E. Project Submittal Part 2
 - 1. Provide for approval no later than sixty (60) days after issuance of Notice to Proceed and in accordance with previously provided submittal schedule.
 - 2. Products:

- a. Section 1: Complete list of products to be incorporated within the Work (Bill of Materials).
 - b. Section 2: Manufacturer's data sheets for each product.
 - 1) Provide original Manufacturer's data sheets in order as they appear in this specification.
 - 2) Data sheets are required for each product in sufficient detail to evaluate product suitability for incorporation within the Work.
 - 3) Product literature shall include documentation of UL listing or approved recognition by a Nationally Recognized Testing Laboratory (NRTL).
 - c. Section 3: Fabric Samples
 - 1) Submit a sample book of each fabric specified, containing manufacturer's standard colors available in the quality of fabric specified for the Owner's selection and approval of color. More than one color may be selected. After selection, upon request, submit one square foot sample of each fabric in each color for final review.
 - d. Section 4: Submit Safety Data Sheets (SDS) for each potentially hazardous material prior to use. Include information pertaining to the hazardous material with the SDS.
3. Drawings:
- a. Provide computer software generated drawings using standard industry graphic standards. Hand or poorly drawn documents will not be accepted. All drawings shall be created on a computer aided drafting (CAD) system. Electronic files of theatrical lighting contract documents shall not be distributed for use in generating submittal documents with the exception of Architectural backgrounds.
 - b. Equipment Drawings:
 - 1) Provide complete assembly details of drapes including stitching schematics, weights, attachment details, and fabric/drape schedule.
 - c. Installation Drawings.
 - 1) Provide detail drawings depicting any unique installation methods specific to each product.
4. Any other pertinent data generated which is necessary to provide the Work.
- F. Submittal Format:
1. Electronic (PDF) submittal documents are required for review.
 2. Provide each submittal with a unique number and each shall be numbered in consecutive order.
 3. Submittals shall not be issued with other disciplines.
 4. Provide each submittal with a complete table of contents with the following information:
 - a. Project Name
 - b. Submittal number. In the case of a resubmittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and shall be numbered in consecutive order.
 - c. Date of submission.
 - d. Referenced specification Section, Part, Article, Paragraph, and page number or drawing reference as applicable.
 5. Follow list by Manufacturer's data sheets, arranged as in Part 2 of this specification. If a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
 6. Drawings executed at an appropriate scale, but not smaller than 1/8" = 1'-0" for conduit/floor plans, 1/4" = 1'-0" for equipment layouts, and 1/2" = 1'-0" for mounting details and panel details.
- G. Resubmission Requirements:
1. Make any requested corrections or change in submittals required. Resubmit for review as directed.

2. Indicate any changes that have been made other than those requested.

H. Approval of Submittals: Each submittal package will be returned with one of the following stamps:

1. “No Exceptions Taken” proceed with construction; all job site coordination will be at the direction of the General Contractor.
2. “Make Corrections Noted: No Resubmission Required” submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made before construction can begin.
3. “Make Corrections Noted: Submit Only Corrected Pages/Items” submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made in writing and returned to the consultant before construction can begin.
4. “REJECTED, Submit Specified Item” a specified item in the submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
5. “REJECTED, Revise and Re-submit” submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
6. “No Review Action Required” all information provided was for information or coordination purposes only. Review is not required.

1.9 PROJECT RECORD MANUAL

- A. Provide electronic copies of the project record documents or as required per the General Conditions of the Project.
- B. The Project Record Manual shall be segregated into three separate bindings as follows:
 1. As-Built Record Documents:
 - a. Product Data:
 - 1) List of all products incorporated in the Project inclusive of all substitutions, field changes, or revisions The list shall include Manufacturer’s serial numbers.
 - 2) Manufacturer's data for each type of product conforming to the scheme above.
 - 3) Organize and bind the above in specification order.
 - b. Record drawings: Final rendition of project drawings enumerated in the Submittal section above. Provide editable computer software generated drawings using standard industry graphic standards. Hand or poorly drawn documents will not be accepted. All drawings shall be created on a computer aided drafting (CAD) system, in both a DWG and PDF file format.
 - c. Test Reports: Record findings of systems testing described in Part 3 below.
 2. Operations Manual
 - a. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
 - 1) This procedure should describe the operation of all system capabilities.
 - 2) Assume the intended reader of the manual to be technically experienced but unfamiliar with the components and the facility.
 3. Service & Maintenance Manual:
 - a. Provide an original copy of the service manual on every piece of equipment for which the Manufacturer offers a service manual. Arrange manuals in the same order as the operations manual.
 - b. Manufacturer’s maintenance and care instructions.
 - c. Maintenance Instructions: include maintenance phone number(s) and hours, maintenance schedule, description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
 4. Warranty Manual:

- a. Manufacturer's warranty statements on each product.
- b. Date of substantial completion and ending dates for warranties for each group of products.
- c. Software registration and licenses.
5. Drapery Flame proofing Documentation:
 - a. Provide all certificates, test reports, and documentation required for drapery flame proofing.
6. Include any other pertinent data generated during the Project or required for future service.
7. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Products shall ship and be stored in their original container to prevent damaging or entrance of foreign matter until installation.
- B. Provide protective covering during construction to prevent damaging or entrance of foreign matter.
- C. Replace, at no expense to the Owner, product damaged during storage, handling, or the course of construction.

1.11 PROJECT CONDITIONS

- A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The Drawings diagrammatically show arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the work may be installed.

1.12 FINAL TESTING AND OBSERVATION

- A. Upon completion of installation and initial tests and adjustments, described in Part 3, acceptance testing shall be performed by the Consultant.
- B. The process of acceptance testing the System may necessitate moving and adjusting certain component parts, such as counterweights on arbors, adjustment of drapery tracks, etc. Perform such adjustments without claim for additional payment.

1.13 WARRANTY

- A. Warrant labor and product for two (2) years following the date of substantial completion to be free of defects and deficiencies and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or product within the Warranty period without charge. Any cost associated with this warranty repair is the responsibility of the Contractor.
- B. This warranty is in addition to any specific warranties issued by Manufacturers for greater periods of time.

- C. Within the warranty period, answer service calls within twenty-four (24) hours during normal working hours and correct the deficiency within forty-eight (48) hours.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed to establish a standard of function, performance, and quality.
- B. Refer to General and Supplementary Conditions and Division 1 Specification Sections for equipment substitution procedure.
- C. Providing product not specifically specified without prior written approval by the Owner, Architect and/or Architect's Consultant shall not be accepted.

2.2 GENERAL

- A. Products shall be new, free from defects and listed by an NRTL when an applicable NRTL Standard exists. Provide product of a given type from one manufacturer.
- B. Regardless of the length or completeness of the descriptions below, provide product that meets or exceeds the specified product's published functionality.

2.3 CONTACTS

- A. Listed below is contact information for Manufacturers of rigging components approved to provide equipment on this project:
 - 1. K&M Fabrics
 - a. 2 Waco Street, Greenville, South Carolina 29611
 - b. Telephone: (800) 845-1896
 - c. Approved to supply curtain fabric.
 - 2. J.B. Martin
 - a. 445 rue St-Jean-sur-Richelieu, Quebec, Canada J3B 2M1
 - b. Telephone: (514) 346-6853
 - c. Approved to supply curtain fabric
 - 3. Rose Brand Fabrics
 - a. 4 Emerson Lane, Secaucus, NJ 07094
 - b. Telephone: (800) 223-1624
 - c. Approved to supply drapery, hampers, and miscellaneous associated equipment.
 - 4. Liba Fabrics Corp.
 - a. 132 W 36th St. 6th Floor, New York, NY 10018
 - b. Telephone: (212) 563-4991
 - c. Approved to supply curtain fabrics

2.4 STAGE DRAPERY

- A. General Specification for Stage Drapery
 - 1. Provide and install all curtains as located and scheduled on the drawings.
 - 2. Field verify all dimensions prior to fabrication of draperies.
 - 3. Curtain fabric of professional grade fabric intended for stage use. If not inherently flame retardant, curtain fabric shall be chemically flame proofed at the mill using an immersion process. Flame proofing certificates for all fabrics used shall be furnished to the owner with the as-built drawings.

4. Sew tags identifying manufacturer and size of panel at each end of webbing at top and at one corner at hem in each drape.
5. Curtains must be constructed with vertical seams unless otherwise specified. The fabric grain shall run nap down and match in all panels. All panels must be un-spliced along their height.
6. Construction
 - a. Black Poly webbing at 4" wide shall be double stitched to the top of the curtain with 1" of face fabric turned under the webbing.
 - b. Brass rustproof grommets shall be inserted
 - 1) at the extreme top corners
 - 2) in the pleat centers of curtains sewn with fullness, or
 - 3) on 12" centers for flat curtains.
 - c. Grommet holes for track mounted curtains shall be supplied with
 - 1) plated wire "S" hooks, or
 - 2) snap hooks, sewn-in at the spacing noted above.
 - d. Drapery hung directly from an auxiliary batten shall have a 24" long black cotton tie line fastened in each grommet hole.
 - e. The centerline of the drape shall be marked on the top webbing with "CL" and a white tie line added to the corresponding grommet.
 - f. Curtains sewn with fullness shall have box pleats spaced 12" on center.
 - g. Bottom hems shall be 4" wide. These shall be sewn with a separate canvas chain pocket inside so that the bottom of the canvas pocket rides 2 inches above bottom of the hem. Provide #8 plated jack chain in the pocket.
 - h. All traveling curtains shall be sewn with a minimum 24" of face fabric turned back at the leading edge. All other vertical hems shall be 2".
7. Use mercerized cotton thread, minimum weight of #16, color to match drape fabric.
8. Fabric colors shall be as scheduled. Submit color sample card with submittal documents. Make all effort to ensure that curtains of the same color are fabricated from fabrics of the same dye lot.
9. Labeling
 - a. Sew labels onto the back (in most cases, upstage) side of the upper hem at both ends of each panel.
 - b. Labels shall clearly indicate
 - 1) date of manufacture
 - 2) cloth type
 - 3) manufacturer's name and address
 - 4) size (width and height using 3/4" minimum lettering
 - 5) owner's designated inventory number
10. Acceptable product:
 - a. For nominal 24-25 ounce fabric
 - 1) KM Fabrics Charisma inherently flameproof velour.
 - b. For nominal 20-21 ounce fabric
 - 1) KM Fabrics Crescent inherently flameproof velour

2.5 MISCELLANEOUS EQUIPMENT

- A. Cloth Hampers:
 1. Provide three (3) castered cloth hampers for storage and transport of loose draperies.
 2. Hampers shall be made from heavyweight canvas with hinged wooden tops, reinforced bottoms and 4" heavy duty swivel casters.
 3. Provide hamper tops with caster donuts to allow stacking of hampers.
 4. Acceptable Product:
 - a) Rose Brand 20 Bushel Hamper

2.6 COMPLETED SYSTEM

- A. General
 - 1. All installation of stage rigging equipment shall be completed utilizing new materials, free from flaws and rust, and in good working order. The jobsite shall be cleaned of all packing materials, lubricants, metal shaving, miscellaneous hardware, and components not used in the installation.
 - 2. All dimensions are to be field verified. Location and attachment of hardware and size of components shall be confirmed by the Contractor.
 - 3. All electrical power, outlets, related systems, and structural elements required to make the system fully functional re the responsibility of the Contractor.
 - 4. If components and hardware are not specifically specified or called out, it is the responsibility of the Contractor to provide those components in order to provide a fully operational theatrical rigging system.
- B. Trimming/Leveling of Drapery
 - 1. Contractor is to return to the jobsite within sixty (60) days, but not less than thirty (30) days of the installation to re-trim all tracks and curtains.
 - 2. Provide documented notes on site visit to Architect and Architect's Consultants on adjustments made during return visit.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.
- B. Mount equipment and enclosures plumb and level.
- C. Permanently installed equipment to be firmly and safely held in place in accordance with specified safety factors and Federal and State codes and regulations.
- D. Work should be completed within industry guidelines, including ESTA, OSHA, ANSI, ASTM, NFPA, plus any or all local, governmental, or other applicable codes.
- E. Where dimensions and loading capacities have been omitted from this specification, they are to be determined by the Contractor, in accordance with the accepted industry standards and guidelines in this section. In no way will the Contractor be relieved of primary responsibility to provide a safe, fully functional system.
- F. The mechanical fabrication and workmanship will incorporate the best practices for good fit and finish. There will not be any burrs or sharp edges to cause a hazard nor will there be any sharp corners accessible to personnel.
- G. All equipment will be installed based on the manufacturer's recommendations and for the use intended by the manufacturer.
- H. All finishes which are disturbed during shipping and installation will be touched up to match the original.

3.2 INSTALLATION OF STAGE DRAPERIES AND TRACK HARDWARE

- A. Install all track mounted draperies to hardware according to track manufacturer's recommendations.

- B. Stage draperies shall be installed near the end of the installation when chances of damage from other work are reduced. Stage area shall be broom clean with no further construction taking place prior to installation.
- C. After hanging stage draperies, thoroughly brush to remove dust, visible dirt, loose threads, loose fabric lint, etc. Wrinkles will be allowed to fall out naturally.
- D. Verify that each drapery panel bears a label as described in paragraph 2.4., A, 9 above.

3.3 FINAL OBSERVATION & TESTING

- A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final inspection and test will be observed by the Consultant.
- B. Contractor will assist in this testing and provide all test equipment noted below.
 - 1. Contractor shall provide at least one (1) person for inspection and two (2) persons for testing familiar with aspects of the System to assist the Consultant.
 - 2. Contractor personnel shall be made available for the entire testing period (day and night), to assist in tests, adjustments, and final modifications.
 - 3. Testing process is estimated to take a minimum of one (1) day.
- C. Testing will include operation of each major system and any other components deemed necessary.
- D. The following procedures will be performed on each System:
 - 1. Inspection of the means and methods employed to incorporate the System within the facility.
 - 2. Verification of proper operation, from controlling devices to controlled devices.
 - 3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the Manufacturer's published specifications. Establish and mark normal settings for each setting, and appropriately record these settings within the Record Documents.
 - 4. Other tests on equipment or systems deemed appropriate.
- E. The Consultant will provide the Owner with a listing describing any incomplete or otherwise deficient items determined as part of the testing process. Where further adjustment or work becomes evident during testing, the Contractor is to continue work until the System is complete.
- F. Stage drapery installer shall return to the jobsite six months after acceptance to:
 - 1. Inspect curtains and attachments
 - 2. Re-trim all curtains.

3.4 INSTRUCTION OF OWNER PERSONNEL

- A. Provide operations and service training on all equipment incorporated in the System.
- B. Training shall not be conducted until final observation and testing is completed by the Consultant, unless otherwise directed by the Owner.
- C. Provide (2) hour of training. Training shall be conducted in accordance with Owner's schedule.
- D. In the event that a portion of the training time is occupied in troubleshooting the equipment installation, then the training time shall be extended an equal amount of time.

- E. Submit an outline of the course with sample instructional aides for approval thirty (30) days prior to scheduled instruction sessions to architect and architect's consultant.

- F. Following discussions with Owner, provide a Training submittal 2-4 weeks prior to first training. Submittal shall:
 - 1. Indicate date, time, and approximate length of training session.
 - 2. Indicate person(s) conducting training.
 - 3. Indicate whether training will be video recorded.
 - 4. Intended curriculum and most appropriate attendees (e.g., technician, operations, IT, etc.)
 - 5. Include signature and title lines for:
 - a. Owner acknowledging and accepting training schedule. Include both an Accepted and Rejected box. An alternate schedule time should be suggested by the Owner in the event the schedule is rejected.
 - b. Countersigning by trainer indicating that training actually occurred.
 - c. All persons attending training. Where attendees do not stay for the entire session, this should be noted on the form and initialed by Owner's representative attending training.
 - d. Owner's representative attending training at the end of the session shall initial that:
 - 1) Training Occurred.
 - 2) Training Materials were provided and left with Owner
 - 3) Training was not interrupted or shortened by equipment or system troubleshooting. If it is, then there should be a line where Owner and Contractor can indicate when make-up training will be provided and how long it should be.
 - 4) Training was generally sufficient for the proposed curriculum.
 - 6. Include Notes section for Owner and Contractor to note any issues during training (areas requiring further development, etc.)

- G. If a representative of the Manufacturer is used in the instructional course, the Contract must be present throughout the extent of the course and ensure that the representative abides by the requirements set forth in these specifications.

- H. Following training occurrence, submit completed training records no later than 5 days following end of training.

END OF SECTION 11 61 43

SECTION 11 61 62 - THEATRICAL LIGHTING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provision of the Theatrical Lighting Systems at the St. Phillip's Watson Fine Arts Center Black Box addition.

1.2 RELATED DOCUMENTS

- A. Theatre Lighting Systems Drawings ("TL" Series) and general provisions of the contract including general and supplementary conditions and Division 1 Specification sections apply to this section.
- B. Section 11 61 33: Theatrical Rigging Systems, drawings, and documentation.
- C. Section 11 61 62: Theatrical Lighting Fixtures and Accessories
- D. Section 27 41 16: Audio Video Systems and Equipment, drawings, and documentation.
- E. Section 11 61 23: Tension Wire Grid System, drawings, and documentation.
- F. Division 26: Electrical Work drawings and documentation.

1.3 SECTION INCLUDES

- A. Project instructions for the Contractor and System description details.
- B. System product descriptions.
- C. Project completion instructions for the Contractor.

1.4 RESPONSIBILITY AND RELATED WORK

- A. Coordination, supply, installation, shipping, storage, inspection, commissioning, testing, instruction and warranties of the Theatrical Lighting Systems.
- B. Plant, materials, equipment, transport and labor necessary to accomplish this and have a complete and fully functioning System.
- C. Also includes:
 - 1. Required licenses and permits including payment of charges and fees.
 - 2. Verification of dimensions and conditions at the job site.
 - 3. Provision of submissions.
 - 4. Installation in accordance with the Contract Documents, Manufacturer's recommendation, and in conformity with applicable codes and authority having jurisdiction.
 - 5. Extension of electrical service, including ground, to equipment locations.
- D. The drawings included with this specification convey general system concepts. Where the plans do not show complete and accurate building details, the Contractor is responsible for making

field measurements necessary to establish exact locations, relationships, and load capacities necessary for the installation of these systems.

- E. Coordinate the work with the related documents and the scheduled work of other trades.
- F. Conduit infrastructure system, including wire for AC Power and grounding for the Theatrical Lighting Systems, are provided as part of the Contract. Coordination between different disciplines is required to achieve a proper conduit system installation and power provisions for Theatrical Lighting Systems. All electrical installation shall be in accordance with Division 26.
- G. Supply accessories and minor equipment items needed for a complete and fully operational system, even if not specifically mentioned in these Specifications or on the associated Drawings, without claim for additional payment.
- H. Notify the Architect of any discrepancies in part numbers or quantities before bid. Failing to provide such notification requires the Contractor to supply items and quantities according to the intent of the Specifications and associated Drawings without claim for additional payment.
- I. Specifications and drawings are complementary. Work called for by one is binding as if called for by both. Any discrepancies between specifications and drawings shall be brought to the attention of the Architect for clarification during the bidding period. No allowance shall subsequently be made to the Contractor by reason of their failure to have brought said discrepancies to the attention of the Architect.
- J. Execute all work in accordance with the NEC and all applicable State and Local codes, ordinances, and regulations.
- K. If a conflict develops between the Contract Documents and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform work.

1.5 REFERENCES

- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
 - 1. American National Standards Institute (ANSI)
 - 2. American Society of Testing and Materials (ASTM)
 - 3. Electronics Industries Association (EIA)
 - 4. Institute of Electrical and Electronic Engineers (IEEE)
 - 5. National Electrical Manufacturer's Association (NEMA)
 - 6. National Electrical Code (NEC)
 - 7. National Fire Protection Association (NFPA)
 - 8. Underwriters Laboratories (UL)
 - 9. Occupational Safety and Health Administration (OSHA)
 - 10. Entertainment Services and Technology Association (ESTA)
 - 11. United States Institute of Theater Technology (USITT)
 - 12. Illuminating Engineering Society (IES)

1.6 DEFINITIONS

- A. In addition to Division 1 definitions, the following list of terms as used in this Section shall be defined as:
 - 1. Owner – Alamo College District
 - 2. Project – St. Phillip's Watson Fine Arts Center Black Box addition.

3. Consultant(s) – The Owner’s Technical Representative(s) for this Section
4. Architect – PBK
5. Contractor – The provider of all material, labor, and equipment necessary for the systems described in this Section
6. Furnish/Supply – To purchase, procure, acquire, and deliver complete with all necessary accessories (CWANA)
7. Install – To set in place, join, attach, link, set up or otherwise connect together and test until complete before turning over to the Owner, all parts, item, or equipment supplied by the contractor.
8. Provide – To furnish and install

1.7 DESCRIPTIONS AND REQUIREMENTS

A. Lighting and Control System: Black Box Theater

1. The Black Box Theatre lighting system shall be comprised of a dedicated network-based control system communicating with the distributed power system and DMX devices to control all lighting elements within the facility.
2. The lighting control console may be located variously within the Black Box. Console shall operate directly over the network.
3. Motorized breaker panel (MBP) shall be located in the designated equipment room. All network and DMX interface control components for the Black Box Theatre shall be located in the Auditorium control distribution rack.
4. Remotely switched power shall be distributed throughout the theatre in flush wall-mounted and batten-mounted devices.
5. Network control shall be distributed throughout the Black Box through a series of plug in ports for use with portable network node equipment and fixed network DMX nodes.
6. Architectural Lighting system shall be capable of supporting the same DMX values as the control console so that looks may be snapshotted then recalled through architectural station presets. This will include control of switched performance lighting circuits, dimmed and switched architectural fixtures.
7. Architectural lighting control stations shall be located throughout the spaces in areas where architectural, work, and running lights will be accessed. Stations shall range from master touch screen, to pushbutton preset recall stations, to on/off switches. The system shall have the ability to “lock-out” stations in order to avoid nuisance switching during performance.
8. Provide connectivity to any need occupancy/vacancy sensor(s) and daylight sensors.
9. Provide theatrical lighting fixtures and required accessories. Installation is required under this base specification and shall include:
 - a. Hang and rough focus to the Owner’s selected hanging plot.
 - b. Set-up, addressing and patch.
 - c. Verification of proper operation and associated training.

B. Focus

1. Contractor will hang, focus, and program lights to an Owner directed plot
2. The Owner may elect to generate their own plot. If not, the Consultant will provide this documentation.
3. If the Contractor finds any needed updates or changes before hang begins the Consultant or Owner will update the documents as needed.
4. The Contractor is responsible for tracking and updating all changes to the plot after it has been turned over for installation. These updates and changes may be provided to the Consultant as necessary. However, the Contractor is responsible for these updates and may be provided the plot in an editable format to make the updates.
5. The Consultant produced plot will provide the following information if applicable for each fixture:
 - a. Location

- b. Unit number for that location
 - c. Type
 - d. Area/purpose
 - e. Mode
 - f. Fixture universe/address
6. As part of turnover documents, the Contractor will be required to ensure the following are provided:
- a. An electronic version of the plot. Provided on a flash drive and preserved by the Contractor for at least the length of the warranty.
 - b. A B-sized version of the plot mounted to foamcore-like material.
 - c. All of the information listed above in number 5 and additionally all circuiting of fixtures.
7. As part of the final observation and testing (3.5) Consultant will verify the focus. The Contractor may elect to complete the focus before the final observation and make any changes noted by the Consultant at this time. If the Contractor elects to have the Consultant direct focus as part of final observation the following shall be provided:
- a. At least (10) days notice
 - b. A board operator
 - c. At least (2) people to perform the focus
 - d. All required lifts and safety equipment
 - e. A focus target. Person or figure
 - f. Person or system to document any changes that arise as part of the focus

C. Console Programming

1. The Contractor shall create a starting show file for the project. The file will be loaded onto the console, provided to the Owner on a flash drive, and preserved by the Contractor for at least the length of the warranty. The Contractor will provide the starting show file to the Owner, if requested, following the requirements laid out in the warranty portion (1.14) of this specification and shall be considered a service call.
2. Owner may select to add, update, or change any of the information below. These changes may be directed before, during, or after initial training. The Contractor will make any requested changes provided any amount of training time is left in the project as outlined in the instruction of Owner personnel of this specification (3.6).
3. At the Owner's request program any fixture, color, or controllable attribute to provided faders.
4. Ensure all areas outlined in the console programming portion of this specification are covered as part of the instruction of Owner personnel of this specification (3.6).
5. Using the provided plot, the Contractor shall create the following console programming at a minimum, if applicable:
 - a. Patching
 - b. Patch all fixtures to channel numbers outlined in the plot.
6. Groups
 - a. (1) group for every area of the plot.
 - b. (1) group for every "row" of front lights
 - c. (1) group for every "row" of front lights from the left
 - d. (1) group for every "row" of front lights from the right
 - e. (1) group for every "row" of top lights
 - f. (1) group for every "row" of backlights
 - g. (1) group for the cyclorama lights
7. Palettes
 - a. Intensity
 - 1) Provide a 70% intensity for use in creating cues
 - b. Color
 - 1) Provide warm (R02) and cool (R3202 or R60) for ease of selection.

- 2) Provide a red (R27), green (R90), and blue (R80) for use on cyclorama fixtures
- 3) A warm white. Roughly 3200K
- c. Focus
 - 1) If movers are provided as part of the project create the following locations:
 - a) Upstage center
 - b) Mid center
 - c) Downstage Center
 - d) All Areas outlined on the plot
 - e) A “wash” focus to use with movers to create texture on the stage when set to a larger beam angle
 - f) If possible, house walls for effects that may take place over the audience.
 - g) If possible, proscenium walls to create an effect on the left, right, and center portions of the arch on the audience side
 - h) Cyclorama or upstage draperies for texturing
8. Interactive Control Display (Magic Sheet)
 - a. Provide an interactive control display to aid in programming and console use
 - b. The interactive display shall utilize a combination of standard and user-defined symbols to generate a fixture layout which copies the light plot as closely as reasonably possible.
 - c. Selectable fixtures will, at a minimum, indicate the following parameters or palettes and their current states:
 - 1) Fixture type
 - 2) Channel
 - 3) Intensity
 - 4) Color
 - 5) Focus
 - d. Provide controls for all groups as described above
- D. Show Controller Programming
 1. Provide Programed Cues for selected events and dates as directed by the Owner
 2. Provide time and calendar cues as directed by the Owner
 3. Cues and looks may include stagnate colors or dynamic lighting shifts as directed by the Owner.
 4. Examples to include but not limited to:
 - a. Lobby day look
 - b. Lobby night look
 - c. New Year look
 - d. Winter look
 - e. College Colors look
 - f. Fiesta look
 - g. Memorial/Independence look
 - h. Veterans Day look
 - i. Christmas/Kwanza look
 - j. Hanukkah look
 - k. St. Patrick’s Day look
 - l. Easter look
 - m. Halloween look
 - n. Valentine’s Day look
 - o. Thanksgiving look
 - p. Generic Seasonal looks (Spring, Summer, Fall, Winter)

1.8 QUALITY ASSURANCE

- A. Contractor's Qualifications: Firm experienced in the provision of systems similar in complexity to those required for this project; and meet the following:
 - 1. No less than five (5) years of experience with equipment and systems of the specified types.
 - 2. Experience with at least five (5) comparable scale projects within the last two (2) years.
 - 3. Engage the services of a Manufacturer certified technician.
 - 4. Be a franchised dealer and service facility for the manufacturer's products furnished.
 - 5. Maintain a fully staffed and equipped service facility.
 - 6. At the request of the Architect, demonstrate that:
 - a. Adequate plant and equipment are available to complete the work.
 - b. Adequate staff with commensurate technical experience is available.

- B. Manufacturer's Qualifications:
 - 1. No less than five (5) years continuous experience in the production of specified type of product.
 - 2. Production shall meet applicable NEMA standards.

1.9 SUBMITTALS:

- A. Provide submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures section unless otherwise indicated.

- B. The submittal information required by the specification is to be presented complete and as submissions noted below. Submittals are a crucial and integral part of the construction process; as such the Owner's consultant will not recommend payment to the Contractor above 25% of the scheduled value of this work until all submittal information has been approved

- C. Submittals must be original work produced by the firm responsible for performing the work defined in this specification. Scanning, photographic copying, materially copying, or any other reproducing the contents of the drawings or specifications contained within the Contract Documents will be marked as unacceptable and not reviewed for any content. No claim shall be made for delay, undue burden, or additional costs for the effort to produce shop drawings, schedules, and equipment lists addressing this specification or the overall project manual.

- D. Project Submittal Part 1:
 - 1. Provide for approval not later than thirty (30) days after issuance of Notice to Proceed and prior to commencement of Work:
 - a. Section 1: A complete schedule of submittals.
 - b. Section 2: A chronological schedule of Work in bar chart form. Revise and resubmit schedule as required to reflect construction progress.

- E. Project Submittal Part 2:
 - 1. Provide for approval no later than sixty (60) days after issuance of Notice to Proceed and in accordance with previously submitted submittal schedule.
 - 2. Products:
 - a. Section 1: Complete list of products to be incorporated within the Work (Bill of Materials).
 - b. Section 2: Manufacturer's data sheets for each product.
 - 1) Provide original manufacturer's data sheets in order as they appear in the specification.
 - 2) Data sheets are required for each product in sufficient detail to evaluate product suitability for incorporation within the Work.
 - 3) Product literature shall include documentation of UL Listing or approved recognition by a Nationally Recognized Testing Laboratory (NRTL).

- c. Section 3: Provide Architect and/or Architect's Consultant with samples of wall plate materials and colors as specified in this section.
 - d. Section 4: Submit Safety Data Sheets (SDS) for each potentially hazardous material prior to use. Include information pertaining to the hazardous material with the SDS.
3. Drawings:
- a. Provide computer software generated drawings using standard industry graphic standards. Hand or poorly drawn documents will not be accepted. All drawings shall be created on a computer aided drafting (CAD) system. Electronic files of theatrical lighting contract documents shall not be distributed for use in generating submittal documents with the exception of Architectural backgrounds.
 - b. Schematic Drawings.
 - 1) Provide drawings detailing cabling-riser intent.
 - 2) Give each component a unique designator and use this designator consistently throughout the project.
 - 3) Include inter- and intra-component connections and cabling diagram depicting cable types, designators, and color codes.
 - c. Installation Drawings.
 - 1) Provide drawings showing the coordinated locations of all installed equipment. Drawings shall include floorplans and other views as necessary to fully describe the intended finished conditions.
 - 2) Provide Conduit and Electrical Drawings indicating:
 - a) Conduit sizing/routing for each system component,
 - b) Locations where power is required along with the location of all junction boxes.
 - 3) Detail Drawings: Provide drawings showing special details depicting methods and means specific to each product, assembly and each product Manufacturer's recommended installation methods and means.
 - d. Equipment Drawings:
 - 1) Rack and Panel Elevations: Provide a front elevation of all racks and/or panels.
 - 2) Rack and Panel Assembly Details: Provide drawings showing location of equipment in racks with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations.
 - 3) Custom Enclosures and Millwork Drawings: Provide full fabrication detail drawings indicating size, material, finish, and openings for equipment.
 - 4) Fabricated Plates and Panels Drawings: Provide complete drawings of custom fabricated plates or panels. Drawings to include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
 - e. Schedule Drawings: Provide load schedules noting source and destination of wiring and associated connected load.
 - f. Labeling Drawing: Provide representative equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and descriptor and designator schedule.
 - g. General Detail Drawings: Provide detail drawings depicting any unique installation methods specific to each product.
 - h. Control Screen Templates: Provide layout drawings and/or screenshots for master house lighting stations and similar electronic control surfaces.
4. Any other pertinent data generated which is necessary to provide the Work.

F. Submittal Format:

1. Electronic (PDF) submittal documents are required for review.
2. Provide each submittal with a unique number and each shall be numbered in consecutive order.

3. Submittals shall not be issued with other disciplines.
 4. Provide each submittal with a complete table of contents with the following information:
 - a. Project Name
 - b. Submittal number. In the case of a resubmittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and shall be numbered in consecutive order.
 - c. Date of submission.
 - d. Referenced specification Section, Part, Article, Paragraph, and page number or drawing reference as applicable.
 5. Follow list by Manufacturer's data sheets, arranged as in Part 2 of this specification. If a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
 6. Drawings executed at an appropriate scale, but not smaller than 1/8" = 1'-0".
- G. Resubmission Requirements:
1. Make any requested corrections or change in submittals required. Resubmit for review as directed.
 2. Indicate any changes that have been made other than those requested.
 3. Approval of Submittals: Each submittal package will be returned with one of the following stamps:
 - a. "No Exceptions Taken" proceed with construction; all job site coordination will be at the direction of the General Contractor.
 - b. "Make Corrections Noted: No Resubmission Required" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made before construction can begin.
 - c. "Make Corrections Noted: Submit Only Corrected Pages/Items" submittals have been returned with conditional approval. Corrections, as indicated on the returned drawings and/or specifications, must be made in writing and returned to the consultant before construction can begin.
 - d. "REJECTED, Submit Specified Item" a specified item in the submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
 - e. "REJECTED, Revise and Re-submit" submittal has been rejected for the reasons noted. Re-submit in compliance with the specifications.
 - f. "No Review Action Required" all information provided was for information or coordination purposes only. Review is not required.
 4. Any of the above stamps may also carry a "PARTIAL" stamp. This indicates that required information noted in the section above was not provided. Omitted items may be noted as part of the reviewed submittal, but it is the Contractor's responsibility to verify all required submittal documentation.

1.10 PROJECT RECORD MANUAL

- A. Provide electronic copies of the project record documents or as required per the General Conditions of the Project.
- B. The Project Record Manual shall be segregated into three separate bindings as follows:
 1. As-Built Record Documents:
 - a. Product Data:
 - 1) List of all products incorporated in the Project inclusive of all substitutions, field changes, or revisions The list shall include Manufacturer's serial numbers.
 - 2) Manufacturer's data for each type of product conforming to the scheme above.
 - 3) Organize and bind the above in specification order.

- b. Record drawings: Final rendition of project drawings enumerated in the Submittal section above. Provide editable computer software generated drawings using standard industry graphic standards. Hand or poorly drawn documents will not be accepted. All drawings shall be created on a computer aided drafting (CAD) system, in both a DWG and PDF file format.
- c. Test Reports: Record findings of systems testing described in Part 3 below.
2. Operations Manual
 - a. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
 - 1) This procedure should describe the operation of all system capabilities.
 - 2) Assume the intended reader of the manual to be technically experienced but unfamiliar with the components and the facility.
3. Service & Maintenance Manual:
 - a. Provide an original copy of the service manual on every piece of equipment for which the Manufacturer offers a service manual. Arrange manuals in the same order as the operations manual.
 - b. Manufacturer's maintenance and care instructions.
 - c. Maintenance Instructions: include maintenance phone number(s) and hours, maintenance schedule, description of products recommended or provided for maintenance purposes, and instructions for the proper use of these products.
4. Warranty Manual:
 - a. Manufacturer's warranty statements on each product.
 - b. Date of substantial completion and ending dates for warranties for each group of products.
 - c. Software registration and licenses.
5. Include any other pertinent data generated during the Project or required for future service.
6. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Products shall ship and be stored in their original container to prevent damaging or entrance of foreign matter.
- B. Provide protective covering during construction to prevent damaging or entrance of foreign matter.
- C. Replace, at no expense to Owner, product damaged during storage, handling, or the course of construction.

1.12 PROJECT CONDITIONS

- A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to the Architect for approval, showing how the work may be installed.

1.13 FINAL TESTING AND OBSERVATION

- A. Upon completion of installation and initial tests and adjustments specified in Part 3, acceptance testing shall be performed by the Consultant.

- B. The process of acceptance testing the System may necessitate moving and adjusting certain component parts; perform such adjustments without claim for additional payment.

1.14 WARRANTY

- A. Warrant labor and product for two (2) years following the date of substantial completion to be free of defects and deficiencies and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or product within the Warranty period without charge. Any cost associated with this warranty repair is the responsibility of the Contractor.
- B. This warranty is in addition to any specific warranties issued by Manufacturers for greater periods of time.
- C. Within the warranty period, answer service calls within twenty-four (24) hours during normal working hours and correct the deficiency within forty-eight (48) hours.
- D. During the warranty period, the Manufacturer shall provide a toll-free 24-hour-per-day number for telephone technical support and service request. If callback is required, calls shall be answered within thirty (30) minutes.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed to establish a standard of product function, performance, and quality. Products or manufacturers listed herein are listed in no particular order or preference.
- B. Refer to General and Supplementary Conditions and Division 1 Specification Sections for equipment substitution procedure. Substitution of any equipment within this specification shall require review and approval by WJHW.
- C. Substitution of specified products with other qualified manufacturers and products will be considered providing:
- D. A request for substitution of each specific product must be made in writing by a bidding Contractor not less than ten (10) business days prior to bid for written approval of the Architect.
- E. Sufficient data of the products is presented for prior approval including technical data, manufacturer's specifications, samples, and, if requested, results of independent testing laboratory tests.
- F. Written permission is obtained for the substitution from the Owner or Owner's Representative.
- G. Providing product not specifically specified without prior written approval by the Owner, Architect, and/or Architect's Consultant shall not be accepted.

2.2 GENERAL

- A. Products shall be new, free from defects and listed by an NRTL when an applicable NRTL Standard exists. Provide product of a given type from one manufacturer.
- B. Provide product of a given type from one manufacturer.

- C. Regardless of the length or completeness of the descriptive paragraph herein, provide product complying with the specified manufacturers' published specifications.

2.3 CABLING AND ACCESSORIES

- A. All cable shall be compliant with NEC and NRTL listed. Any NRTL listing must be available at the time of bid.
- B. All electrical conductors installed under this contract, except where otherwise specified, shall be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper, and meet appropriate ratings (e.g., CMR, CMP, etc.)
- C. Cable shall carry appropriate fire rating (e.g., CMR, CMP, OFNR, OFNP, etc.) on jacket of cable.
- D. Where cables are routed through cable tray, provide tray rated cable of equal specification.
- E. Where cables are run exposed through a return air plenum, provide plenum rated cable of equal specification.
- F. Shielded cables located in raceways shall have aluminum foil shield with drain wire.
- G. The Belden cables listed below are approved for use on this project and are listed to set the acceptable standard of performance. If field conditions or actual cable pathway requires tray or plenum cable, provide version of cable that meets required rating. Cables from Carol, Liberty, and West Penn are also acceptable provided they meet the performance specifications of the approved listed cables.
- H. DMX512 (E-DMX) distribution cable:
 - 1. Provide 24 AWG four twisted pair data cable.
 - 2. Pair Color Code Chart:
 - a. 1 – White/Blue Stripe and Blue
 - b. 2 – White/Orange Stripe and Orange
 - c. 3 – White/Green Stripe and Green
 - d. 4 – White/Brown Stripe and Brown
 - 3. Insulation: Polyolefin
 - 4. Inner/Outer Jacket Material: PVC – Polyvinyl Chloride
 - 5. Nominal Impedance: 100 ohms.
 - 6. Nominal Velocity of Prop.: 72%
 - 7. Capacitance between conductors: 15.0 pF/ft.
 - 8. Acceptable product:
 - a. Belden 1583A (Category 5E).
- I. DMX512 (E-DMX) distribution cable – Stage Electric Drops:
 - 1. Provide extra rugged, flexible control cable (Ethernet) for connection of NET outlets on grid to electric batten distribution.
 - 2. Cable to be four-pair, double shielded, low-capacitance.
 - 3. Conductors: 26 AWG tinned, annealed copper stranded 7 x 0.16.
 - 4. Connector: Provide with EtherCon connector by Neutrik®.
 - 5. Assembly: pairs cabled with Kevlar strength member.
 - 6. Shield: (inner) aluminum/Mylar, 100% coverage (outer) tinned copper braid, 80% coverage.
 - 7. Conductivity: 15ohms per 100 meters @ 20C.
 - 8. Impedance: 100 ± 15 ohms 1-100MHz.
 - 9. Acceptable product:

- a. TMB & Associates ProPlex or equivalent.

- J. DMX512 Backup Control Signal Distribution Cable:
 1. Provide 24 AWG two twisted pair cable.
 2. Insulation: Foam polyethylene.
 3. Shield: aluminum foil/polyester tape.
 4. Capacitance between conductors: 12.5 pF/ft.
 5. Acceptable product:
 - a. Belden 9729

- K. Architectural Lighting DMX Cable:
 1. Provide 24 AWG two twisted pair cable.
 2. Insulation: Foam polyethylene.
 3. Shield: aluminum foil/polyester tape.
 4. Capacitance between conductors: 12.5 pF/ft.
 5. Acceptable product:
 - a. Belden 9842

- L. Preset Station Signal Distribution Cable:
 1. Provide 16 AWG single twisted pair cable.
 2. Insulation: PVC-polyvinyl chloride.
 3. Shield: unshielded.
 4. Capacitance between conductors: 33 pF/ft.
 5. Acceptable product:
 - a. Belden 8471

- M. Multi-Conductor SO Type Cable:
 1. Provide multi-conductor cable with black neoprene jacket.
 2. Conductivity: not less than 98%.
 3. Conductor: soft drawn annealed stranded copper.
 4. Minimum Conductor Temperature: 90° C.
 5. Size: No. 12 AWG minimum.
 6. No. of Conductors: As required by circuits shown.
 7. Acceptable product:
 - a. Cole Wire & Cable
 - b. Carol
 - c. Rome

2.4 POWER DISTRIBUTION

- A. Wall-Mounted Motorized Breaker Panels (MBP)
 1. General
 - a. Breaker Panels shall be UL Listed,
 - b. Breaker Panels shall consist of a main enclosure with 12, 24, or 48 pole breaker subpanels, integral control electronics for low voltage terminations and provision for accessory cards
 - c. The panel shall be constructed of 16-gauge galvanized steel. All panel components shall be properly treated or finished in fine-textured, scratch resistant paint
 - d. The unit shall provide interior cover over the control electronics and accessory cards to allow access only to class 2 wiring and prevent direct access to class 1 line voltage components
 - e. Circuits as described in schedule
 - f. Breakers shall provide manual switching control while power is unavailable

2. Each panel shall have a keypad and LCD display for rack configuration, backup, and fault indication.
 3. Panels shall employ USITT DMX-512 control format.
 4. An Ethernet connection shall provide advanced control of relays over streaming ACN (sACN) and transmit status, control override, and measured energy usage per branch circuit via an internal Web UI or central monitoring interface
 5. The panel shall have a UL924-listed contact input for use in Emergency Lighting systems.
 6. Electrical
 - a. Breaker Panels shall be available to support power input from:
 - 1) 120/208V three phase 4-wire plus ground
 - b. Breaker panels shall support main circuit breaker options:
 - c. As required for functional system based on existing electrical service or Division 26 documents
 7. Breaker Panel Accessories
 - a. A low voltage 0-10V dimming option shall provide up to 24 0-10v control outputs that are linked to relay circuits within the panel. Each output shall support up to 400mA of current sink per output
 - b. A contact input option shall provide 24 dry contact inputs to be linked for direct or group relay control, to activate a preset, or to activate a sequence. Controller software shall allow for normally open maintained, normally closed maintained, or momentary toggle
 8. Provide with main disconnect breaker option.
 9. Quantity: As shown in drawings
 10. Acceptable Product
 - a. Lyntec - LCP Series Lighting Control Panelboards
 - b. Vari-Lite – RigSwitch+
 - c. Electronic Theatre Controls – Sensor IQ Panel
- B. Distribution Wiring Devices
1. General
 - a. All power distribution devices overall assembly shall be listed by a nationally recognized test lab.
 - b. All dimmed circuit connectors shall be 20A grounded stage pin type. All switched circuits connectors shall be 20A twistlock type. All connector types provided shall be of a single manufacture.
 - c. All pigtails shall be three-wire type “SOW” rubber jackets cable. All pigtails to be provided with proper strain relief.
 - d. All power distribution devices shall be fabricated from minimum 18-gauge galvanized steel and finished in black fine-textured powder coat paint unless noted otherwise. Boxes shall be free from burrs, sharp corner, and overhanging edges.
 - e. Circuits for Raceways and Plugging Boxes shall be labelled with 2” yellow on black Brady numbers. Numbers shall be located so that they are not obscured by cabling. Circuits shall be assigned and labelled per schedules on drawings
 - f. Circuits for Wall Boxes and Floor Pockets shall be labelled with 1” yellow on black Brady numbers. Numbers shall be located so that they are not obscured by cabling. Circuits shall be assigned and labelled per schedules on drawings. As a rule, circuits shall number Stage Left to Stage Right, Down stage to Upstage.
 - g. All power distribution devices shall be provided with appropriate mounting hardware.
 - h. All multi-conductor cable is to be provided with Kellems-type strain relief grips at each end of the cables with intermediate strain relief as required.
 - i. Provide connector strips, gridiron junction boxes (GIJB), and associated hardware for over the stage lighting. Coordinate connector strip lengths for electrics with the theatrical rigging equipment. Provide all multi-conductor cables allowing the

- devices to fly to a low trim as indicated on the TR sheets. The cable is to be provided with necessary cable strain relief grips as part of the cable management system. Provide rugged network control cables to parallel the multi-conductor cable runs. Verify all electrical circuits and label all circuit numbers as specified.
2. Wall Mounted Boxes (WB)
 - a. Provide a wall plug-box designed for recessed mounting.
 - b. Construction: code gauge steel.
 - c. Connectors: female 20 Ampere twistlock-type connectors surface mounted in the plug-box.
 - d. Circuits: number of circuits as specified on drawings.
 - e. Labeling: circuits are labeled with yellow letters on black background.
 - f. Overall assembly UL listed.
 - g. Quantity: As shown in drawings.
 - h. Acceptable product:
 - 1) Altman 450 series
 - 2) ETC 9200 series
 - 3) Vari-Lite 9600 series
 - 4) SSRC RM series
 3. Pipe Mounted Boxes (PB)
 - a. Provide a plug box designed for pipe mounting.
 - b. Construction: code gauge steel.
 - c. Pigtails: SO type cable. Provide lengths as shown on drawings.
 - d. Connectors: female 20A twistlock connectors on the end of each of the pigtails and flush mounted 20A parallel blade receptacles for convenience circuits.
 - e. Circuits: number of circuits as specified on drawings.
 - f. Labeling: circuits are labeled with yellow letters on black background.
 - g. Overall assembly UL listed.
 - h. Quantity: As shown in drawings.
 - i. Acceptable product:
 - 1) Altman 450 series
 - 2) ETC 9300 series
 - 3) Vari-Lite 9600 series
 - 4) SSRC PM series
 4. Distributed Dimming
 - a. Provide DMX-controlled portable dimmer module design for silent operation for use with conventional fixtures
 - b. Module to be constructed from aluminum with anodized aluminum heat sink.
 - c. Color: black
 - d. Module to operate using 120V power from 20A circuits located in system distribution devices.
 - e. Power lead connectors
 - 1) Input: twistlock
 - 2) Output: parallel blade (Edison)
 - f. The module shall have 2500V isolation between power and control components.
 - g. Module to be convection cooled
 - h. Module to be yoke or pipe mounted. Supply with C-Clamp
 - i. Accessories:
 - 1) Provide with 10' power extension with twist-lock connector
 - 2) Provide with 10' DMX data cable and DMX terminator.
 - j. Quantity: (8)
 - k. Acceptable products:
 - 1) ETC single module distributed dimmer ES750
 - 2) Vari-Lite LIGHTPACK module

2.5 CONTROL EQUIPMENT

- A. Control Distribution Rack (CDR)
 - 1. The control distribution rack shall be an EIA compliant 19" wall mount rack.
 - 2. Center section and back pan shall be 16 gauge steel, finished in a black textured powder coat.
 - 3. Rack rails shall be constructed of 11 gauge steel with tapped 10-32 mounting holes in universal EIA spacing.
 - 4. Rack height shall be sized to contain all equipment as shown in the contract documents.
 - 5. Rack shall have an overall depth of 22.3." Useable depth shall be 20," extending into the back pan 3.5."
 - 6. Accessories:
 - a. Provide a Furman M-8Lx type pull out panel light in the rack.
 - b. Provide a magnetic LED work light with 36" power supply cord.
 - c. Provide one (1) locking storage drawer and all necessary vent or blank panels.
 - 7. The control distribution rack shall be provided by the Lighting Control System Manufacturer.
 - 8. Quantity and details: As shown on drawings
 - 9. Acceptable product:
 - a. Mid-Atlantic DWR series

- B. UPS Backup Power / Surge Protection
 - 1. Provide a rack mountable UPS backup to support equipment located in the control distribution racks (provide with one (1) spare battery).
 - 2. Output Power Capacity: 1400VA/1050W
 - 3. Input 120V/ Output 120V
 - 4. Interface Port: DB-9 RS-232
 - 5. Extended runtime model
 - 6. Rack Height: 2 Units
 - 7. Filtering: Full time multi-pole noise - filtering: 0.3% IEEE surge let-through: zero clamping response time: meets UL 1449
 - 8. The UPS shall be provided by the lighting control system manufacturer.
 - 9. Quantity: As shown in drawings.
 - 10. Acceptable product:
 - a. APC
 - b. Tripp Lite
 - c. Middle Atlantic

- C. Control Components
 - 1. Ethernet Switches (ESW)
 - a. Provide business grade Gigabit PoE+, Layer 2 managed Ethernet switches in the CDR as shown in the TL series documents.
 - b. Switch shall include 24 POE+ ports meeting IEEE802.3at standard
 - c. Switch shall include port routing via separate VLAN subnets
 - d. Switch shall be equipped with LED indicators for power status, port status, bandwidth utilization, collision detection and speed indication.
 - e. Switch shall have a built-in web-based management interface to provide easy to use management through a standard browser. Provide with all required software management tools.
 - f. Provide rack mount kit and required hardware and cables for stacking.
 - g. Each network location shall have a dedicated input point on the network switch. Dedicated input points shall be clearly labeled to identify connected network device at the patch panel. Patching shall not be required.
 - h. Ethernet switch shall be tested and approved by Lighting Control System Manufacturer for compatibility with all connected devices.
 - i. Quantity: As required by design
 - 2. Network Node/Gateway

- a. Provide rack-mounted DMX Ethernet node/Gateway to generate DMX to devices located at theatrical and house architectural lighting positions
 - b. Nodes shall have (4) screw terminal or 5-pin DMX connectors for a total of 4 DMX universes for distribution over the Ethernet system.
 - c. DMX Node shall have LEDs for indication of power, network activity, and DMX port configuration.
 - d. Each input shall route directly to the Ethernet Switch located in the assigned Dimmer Rooms without the need for patching.
 - e. Quantity: As required by design.
 - f. Acceptable product:
 - 1) Pathway rack or DIN rail mounted gateway
 - 2) Vari-Lite rack or DIN rail mounted gateway
 - 3) ETC rack or DIN rail mounted gateway
3. Show Controller
- a. Provide control of theatrical, house, and architectural lighting fixtures
 - b. Provide (6) universe of control of DMX/RDM and DMX over Ethernet control
 - c. Provide remote programming interfaces to include:
 - 1) Input from Video Board outside of Fine Arts Building
 - 2) Office 170
 - a) Include an off-campus remote interface. Provide needed software on Owner provided computer(s).
 - d. Acceptable product:
 - 1) Mosaic Controller
 - 2) Neo Playback Controller
4. eDIN Demultiplexer Module:
- a. Provide a rack mounted DMX to 0-10v signal converter for house lighting as required. Reference Division 26 documents.
 - b. Each architectural circuit shall have an independent output by the Demultiplexer; there shall be no daisy chain runs between circuits.
 - c. Quantity: As required by Design.
 - d. Acceptable product:
 - 1) Pathway Connectivity #1004 Demultiplexer (DMX-to-Analog)
 - 2) ETC Response 0-10V Gateway
- D. Plates and Devices
1. Network Receptacle Station/Gateway (NET)
 - a. Provide a remote plug-in station for connection of control console and portable DMX Gateways at control booth and other locations as noted in the drawings.
 - b. Station shall be provided with a Neutrik RJ45 jack. Each jack shall be rated for use in harsh commercial conditions.
 - c. Station will contain the following components:
 - 1) RJ 45 jack with punch down block, provide Neutrik EtherCon type receptacle as indicated on drawings.
 - 2) Station faceplates shall be .80" aluminum, finished in fine texture, scratch-resistant black powder coat.
 - 3) Station back box will be a minimum of 2.5 inches.
 - 4) Station shall have silk screened graphics white in color.
 - 5) Provide a Lamacoid label that de-notes, using an alpha-numeric labeling convention, the switch location and network port number.
 - d. These network connections shall also be configured with a back box and mounting hardware for mounting on the FOH lighting galleries or backstage.
 - e. Each Network jack will route directly to the Ethernet Switch located in the assigned Dimmer Rooms without the need for patching.
 - f. No daisy chaining between jacks or splicing of Category 5e and above cable is allowed.

- g. Quantity: As shown in drawings.
 - h. Acceptable product:
 - 1) Pathway Network station
 - 2) Var-Lite station
 - 3) SSRC station
 - 4) ETC Network station
2. DMX512 Distribution Box/Network Gateway (NN1/NN2):
- a. Provide a plug-in box designed for pipe mounting.
 - b. Node shall provide the quantity of universes, as specified, of DMX512 control for intelligent lighting or other DMX512 addressable devices.
 - c. Power for the node shall be provided over the Cat6 cable via the network switch. All nodes shall be IEEE 802.3af compliant and UL listed. Power consumption shall not be greater than 3 watts.
 - d. Ports:
 - 1) DMX Ports shall comply with the requirements of the USITT DMX512.
 - 2) The DMX port shall be software-configurable for either input or output.
 - 3) DMX inputs shall be fully opto-isolated from the node electronics and from each other.
 - 4) DMX outputs shall be earth-ground referenced.
 - 5) DMX Ports shall be capable of withstanding fault voltages of up to 250VAC without damage.
 - e. Node modules will mount within a standard electrical box or enclosure.
 - f. Each input shall route directly to the Ethernet Switch located in the assigned Dimmer Rooms without the need for patching.
 - g. Quantity: As shown in drawings.
 - h. Acceptable product:
 - 1) Pathway Connectivity Pathport Node
 - 2) Var-Lite Node
 - 3) ETC DMX Node
3. Portable Network Gateways:
- a. Provide portable output nodes and input node for pipe mounting at any NET station.
 - b. Each node shall be equipped with a molded RJ 45 connector on a jacketed cable (see specification for flexible Category 6 cable) for connection to the lighting control network (NET).
 - c. Node shall provide the quantity of universes, as specified, of DMX512 control for intelligent lighting or other DMX512 addressable devices.
 - d. Power for the node shall be provided over the Category 6 cable via the network switch. All nodes shall be IEEE 802.3af compliant and UL listed. Power consumption shall not be greater than 3 watts.
 - e. Ports:
 - 1) DMX Ports shall comply with the requirements of the USITT DMX512.
 - 2) The two DMX ports shall be software-configurable for either input or output.
 - 3) DMX inputs shall be fully opto-isolated from the node electronics and from each other.
 - 4) DMX outputs shall be earth-ground referenced.
 - 5) DMX Ports shall be capable of withstanding fault voltages of up to 250VAC without damage.
 - f. Double Universe Node shall contain the following components:
 - 1) RJ 45 connector. Connector is to be RJ Lnx model ENSAM315.
 - g. Provide C-clamp for pipe mounting.
 - h. Quantity: (2) Output Nodes and (1) Input Nodes
 - i. Acceptable product:
 - 1) Pathway Connectivity Pathport Node
 - 2) Var-Lite Node

- 3) ETC Portable DMX Node
4. DMX512 Distribution (DMX):
 - a. Provide DMX512 distribution for connection to wiring devices in the Classroom and Auditorium.
 - b. Modules shall provide one optically isolated DMX512 signal output capable of driving thirty-two (32) receiving devices on a single DMX line.
 - c. Provide a wall plugging box designed for surface mounting.
 - d. Construction: code gauge steel.
 - e. Connectors: Neutrik 5 conductor XLR, flush mounted.
 - f. Circuits: located as shown on the drawings.
 - g. Labeling: labeled with yellow letters on black background.
 - h. Quantity: As shown in drawings.
 - i. Acceptable product:
 - 1) Pathway Connectivity station
 - 2) Var-Lite station
 - 3) SSRC station
 - 4) ETC station
5. Control Receptacle Station (CRS)
 - a. Provide a flush-mounted control station for connection of the control console (over network or hard DMX back-up) and portable house light controller.
 - b. Station will contain receptacle components as described on the drawings.
 - c. Station faceplates shall be .80" aluminum, finished in fine texture, scratch resistant black powder coat.
 - d. Station Back box will be a minimum of 2.5 inches deep
 - e. Station shall have white, silk screened graphics
 - f. Provide a Lamacoid label for network jacks that denotes, using alpha-numeric labelling convention, the switch location and network port number.
 - g. Each network jack shall route directly to the Ethernet switch without the need for patching.
 - h. No daisy-chaining between jacks or splicing on network cabling is allowed.
 - i. Quantity: As shown in drawings.
 - j. Acceptable product:
 - 1) Pathway Connectivity station
 - 2) Var-Lite station
 - 3) SSRC station
 - 4) ETC station
6. Portable Relay and Control Modules
 - a. Provide a yoke or pipe mount wireless transmitter and receiver system for control and power switching.
 - b. Transmitter shall broadcast DMX-512 signal in 2.4Ghz range with frequency hopping ability to eliminate risk of interference. Latency between transmitter and receiver shall be no more than 7mS
 - c. Minimum 2500V isolation shall be provided between control and power components
 - d. Wired DMX In and Thru connections shall be made using five-pin XLR connectors
 - e. Power Input and output connectors shall be PowerCon compatible.
 - f. Relay shall support DMX512A In and Thru via five-pin XLR connectors
 - g. Provide transmitter and receiver with yoke and pipe mount kits.
 - h. Acceptable product and Quantities:
 - 1) ETC Color Source Relay (1) transmitter and (4) receivers

2.6 CONTROL CONSOLE AND ACCESSORIES

A. Overview

1. Provide a control console for direct operation of theatrical fixtures and development of user-presets to be stored for recall via the Architectural Control Sub-system specified in this section.
2. Provide initial setup as directed as part of the system commissioning process.

B. Control Console

1. The lighting control console shall be a microprocessor-based system specifically designed to provide complete control of stage, studio, and entertainment lighting systems.
2. The system shall also be able to control third party ACN devices directly. The system shall provide control of 2,048 or 12,288 outputs on a maximum of 32,768 control channels.
3. A maximum of 10,000 cues, 999 cue lists, 1,000 groups, 1,000 presets, 4 x 1,000 palettes (Intensity, Focus, Color and Beam), 1,000 effects, 1,000 macros and 1,000 curves may be contained in non-volatile electronic memory and stored to an onboard hard disk or to any USB storage device.
4. The console may be placed in Tracking or Cue Only mode by the user as a system default and overridden on individual record actions as required.
5. A Master Playback fader pair and dedicated Grand Master/Blackout shall be provided.
6. Up to six USB fader wings may be connected to the console, for a maximum of 300 submasters and/or 200 playback faders. USB fader wings may be rigidly connected to the main console to provide a "single connected unit" with no external cables required. The wings also may be connected via USB cables and used "on the side."
7. A high-resolution level wheel shall be provided to control intensity for selected channels and scrolling within selected displays. Four page-able high-resolution encoders shall be provided for control of other non-intensity parameters. Non-intensity parameters shall be controllable via the encoders or keypad controls, without need of an external pointing device.
8. Rotary encoders for non-intensity parameters shall be labeled by means of an integral LCD display mounted above or below the encoders on the main console. The display shall show the currently loaded functions of the encoders based on the current selections. Systems using encoders with no LCD labeling shall not be acceptable.
9. Control and programming features for automated fixtures shall also include: a standard library of fixture profiles, the ability to copy and edit existing profiles and create new profiles, patch displays including channel and output addressing, 16-bit fade resolution, color characterization allowing color mixing and storing in Hue and Saturation or native device values.
10. The system shall direct user input through on-screen dynamic prompts and integral LEDs on console keys indicating current operating mode. A context sensitive on-line Help feature shall explain and provide an example of the operation of each feature of the system.
11. A row of softkeys shall be provided, which change function based on the selection and context of the console. These softkeys shall be labeled via an adjacent LCD display that shows their current functions at all times. Systems using softkeys with no LCD display shall not be acceptable.
12. Console software upgrades shall be made by the user via a USB port; changing internal components shall not be required.
13. The console operating software shall be loaded into program execution memory from the internal hard drive when the console is powered. In the event of an uncontrolled shutdown, the console shall return to its last output state when power is restored.
14. Console power shall be 95 – 240V AC at 50 or 60Hz, supplied via a detachable power cord.
15. Accessories:

- a. Provide (2) external touch screen high resolution DVI monitors that will display system information, including playback status, live output and blind values for all record targets.
 - b. Provide (1) fully-functioning, detachable alphanumeric keyboard. The keyboard shall allow labeling of channels, cues, presets, groups, palettes, effects, macros, curves and the show. An integral electronic keyboard shall be provided.
 - c. Provide console client software kit
 - d. Provide one (1) 1x20 fader wing with associated power supplies.
 - e. Provide with dust cover
 - f. Provide with USB mouse
 - g. Provide with 25' network cable
 - h. Provide (1) Littlite with 3-pin XLR connector
 - i. Provide (1) USB jump drive, minimum 8gb
16. Quantity (1)
17. Acceptable product:
- a. Electronic Theater Controls ION XE 20 with 2,048 channels of control.
- C. Handheld Remote Focus: (Auditorium Stage)
1. The portable access unit shall be a wired or wireless remote-control device that allows access to console programming and playback functions.
 2. The device shall be an 8-inch tablet with a capacitive multi-touch display.
 3. Remote unit shall connect through an RJ45 and wirelessly via a WAP
 4. Contractor shall provide WAP that meets District standards for WiFi function and security
 5. Contractor shall provide the following accessories:
 - a. Charging/cable Adaptor
 - b. Hand Strap.
 - c. Shoulder Strap
 - d. EETI Stylus Pen
 - e. Office Dock
 - f. VESA Dock
 6. Acceptable product:
 - a. Electronic Theatre Controls ETCpad
- D. Rolling Storage/Operator Cart
1. Provide a portable storage and operator cart for the control console.
 2. Nominal dimensions shall be 41" W x 26" D x 40" H.
 3. Unit shall include the following options:
 - a. 19" equipment rack frame sized for 10RU
 - b. 35" locking aluminum keyboard drawer
 - c. (4) 8" swivel casters with brakes and position locks.
 - d. (1) removable side panel
 - e. (1) flip-up side panel extension
 - f. Top desk surface to include:
 - 1) Dual post, articulating monitor mount
 - 2) Power connections for (3) AC outlets and (1) dual USB charger
 4. Quantity: (1)
 5. Acceptable product:
 - a. Bigfoot Mobile Systems "Side Operator" XL cart

2.7 ARCHITECTURAL CONTROL SYSTEM

- A. Processing – Provide either a rack mounted control processor located in the control distribution rack or provide distributed processing at each control station.

1. The processing rack shall receive output data from a lighting control console and/or architectural control stations, process the information it receives and distribute the information to DMX-controlled panels and devices.
 2. Processing Racks shall be designed to support the following wire terminations:
 - a. AC (single phase)
 - b. Echelon link power
 - c. 24Vdc
 - d. DMX512 In
 - e. DMX512 Out
 - f. RS232 Serial In/Out
 - g. Net3 Unshielded Twisted Pair (UTP) or ST fiber optic
 3. Coordinate integration of audio-visual system with contractor and program system as directed by the End User.
- B. Configuration – Configure architectural control system screens in conjunction with User prior to commissioning. Base configuration shall accommodate the following basic layouts:
1. Main Navigation
 2. User configurable named presets (2 pages to be programmed at training)
 3. House light individual control
 4. House light presets
 5. Work light individual control
 6. Work light presets
 7. Blue light individual control
 8. Blue light presets
- C. Stations - General
1. Master stations shall be located in the control booth, backstage and as noted on the contract documents.
 2. Provide preset stations as described below and shown in drawings.
 3. All audience exposed switches shall be provided with locking covers and shall be painted a custom color as determined by the architect.
- D. Show Controller
1. Provide control of color mixing theatrical or houselight fixtures.
 2. Provide 4 Universes of DMX/RDM and DMX over Ethernet control.
 3. Acceptable product:
 - a. Electronic Theatre Controls Mosaic Show Controller
 - b. Vari-Lite Neo X Server
- E. Acceptable product:
1. Electronic Theatre Controls Paradigm System with Ern
 2. Var-Lite Vision.net
 3. Interactive Technologies CueServer3 Pro
- F. House Lighting Fixture Control
1. Contractor shall be responsible for installation and termination of DMX and/or 0-10v to all architectural house light fixtures. It is the Contractor's responsibility to verify operation on ground before fixtures are permanently installed. Any required DMX and/or 0-10v controlled interface shall be provided by the Contractor including equipment parts, labor and installation of equipment.
- G. Control Stations/Receptacles
1. House Light Master Station (HLM)
 - a. Provide full color 7" LCD touchscreen master station.
 - b. Station shall be wall mounted or rack mounted as shown on drawings

- c. Station finish shall be black in technical areas and color selected by Architect for public spaces.
 - d. Station shall be configurable with system software via USB, serial data and Network interface
 - e. Station shall have the ability to store multiple configurations with the User being able to select which is active.
 - f. Station shall accommodate individual zone control, preset record and selection function.
 - g. Station shall be able to lock out preset stations located in the facility.
 - h. Master station shall have local control for each work light, house lights, running lights and other settings as required by the Owner.
 - i. Quantity: As shown on the drawings.
 - j. Acceptable product:
 - 1) Electronic Theatre Controls – Unison Paradigm touchscreen station
 - 2) Var-Lite – Vision.net touchscreen station
 - 3) Interactive Technologies – CueServer3 Pro Insite touchscreen station
2. Portable House Light Master Station
- a. Provide a portable house light master station as specified above with a clam type protective cover that also functions as a stand.
 - b. Provide with 25' detachable connection cable.
 - c. Quantity: (1)
 - d. Acceptable product:
 - 1) Electronic Theatre Controls – Unison Paradigm handheld touchscreen
 - 2) Var-Lite – Vision.net portable touchscreen station
 - 3) Interactive Technologies – CueServer3 Pro Insite touchscreen station
3. Push Button Preset Stations (HL2, HL5, HLT)
- a. Provide two, five and ten push button stations as shown on drawings
 - b. Stations shall be mounted within a one-gang back box
 - c. Station finish shall be black in technical areas color selected by Architect for public spaces.
 - d. Two button stations (HL2) shall be programmed for on/off operation with on button being a fully programmable preset
 - e. Five button stations (HL5) shall have four programmable presets plus off. Presets may include house lights, work lights, blue lighting and will be programmed with the User.
 - f. Ten button stations (HLT) shall have nine programmable presets plus off. Presets may include house lights, work lights, blue lighting and will be programmed with the User.
 - g. Quantity: As shown on the drawings.
 - h. Acceptable product:
 - 1) Electronic Theatre Control Unison Heritage
 - 2) Var-Lite Vision.net
 - 3) Interactive Technologies Ultra Stations
4. House light entry station (HLE)
- a. Provide keyed on/off switched stations as shown on drawings for house cleaning/maintenance lighting.
 - b. Stations shall be mounted within a one-gang back box
 - c. Station finish color shall be selected by Architect.
 - d. The key switch shall initiate the pre-programmed preset. This shall be a single action, not requiring keyed take control then initiating a preset.
 - e. Quantity: As shown on the drawings.
 - f. Acceptable product:
 - 1) Electronic Theatre Control Unison Heritage
 - 2) Var-Lite Vision.net

2.8 MISCELLANEOUS

- A. LED Stage Electric Work Lights
1. Provide a high output LED work light capable of clamping onto the top batten of the stage electrics.
 2. Construction: Heavy duty anodized extruded aluminum housing. All materials shall be corrosion resistant.
 3. Rating: 120/240 volts AC/DC operation.
 4. Cable: 36" Teflon leads encased in black fiberglass sleeving.
 5. Connectors: (1) male parallel blade
 6. Yoke: Rigid flat steel with locking dog tilt handle.
 7. Finish: All black enamel
 8. Provide with yoke and c-clamp hardware
 9. Quantity: (8)
 10. Acceptable product:
 - a. Altman LED Work Light
 - b. SSRC LED Work Light, 150W Warm White
- B. Rolling Safety Light
1. Provide castered stand with safety caged compact fluorescent 100 watt equivalent lamp.
 2. Provide (1) 30' 12/3 cable terminating in a 20A U-ground connector. Mount cable hanger to stand.
 3. Quantity: (1) Custom Safety Light
 4. Acceptable product(s):
 - a. Altman 526/5-9 with listed accessories

2.9 PORTABLE LIGHTING FIXTURES AND ACCESSORIES

- A. Provide and integrate the following equipment into the project.
1. Theatrical Lighting Fixtures
 - a. The portable lighting fixtures shall connect and be controlled by the new theatrical lighting control system.
 - b. All fixtures shall be listed by UL or an OSHA approved NRTL.
 - c. Fixtures shall be constructed of rugged die cast aluminum with high impact knobs and handles unless otherwise noted.
 - d. Fixtures shall be provided with a black finish unless otherwise noted.
 - e. Fixtures shall have a rugged steel yoke with a positive locking clutch which will allow for a 300° body rotation.
 - f. All fixtures shall be provided with color frame, power lead with mating grounded connector, safety cable, and c-clamp. All safety cables and c-clamps shall be black.
 - g. Fixtures shall be:
 - 1) Labeled with the Owner's mark and select numbering/labelling inventory scheme.
 - 2) Bench-focused, if necessary.
 - 3) Hung in the Owner's selected stock plot.
 - 4) Patched at the console.
- B. LED-type fixtures
1. Provide (1) power pass-through and (1) DMX extension cable at 10 ft. length for each LED-type fixture included in the inventory. All cables shall adhere to requirements set forth below in Cables and Accessories portion of this specification.
 2. All LED-type fixtures shall support ANSI E1.11 DMX512-A and ANSI E1.20 RDM standards.

3. All LEDs used in the product shall be high brightness and proven quality from established and reputable LED manufacturers.
4. Manufacturer of LED emitters shall utilize an advanced production LED binning process to maintain color consistency.

C. Fixtures – Type and Quantity

1. Color-changing LED Profile
 - a. Provide an RGBL color mixing high-intensity LED illuminator with DMX controlled intensity and color;
 - b. Unit shall have a shutter assembly with (4) blades mounted in two or more planes. Shutter blades shall be warp and burnout resistant;
 - c. Unit shall have two accessory slots, a top-mounted quick release gel frame retainer, and a slot with sliding cover for motorized pattern devices or optional iris.
 - d. Unit shall have projector-like quality pattern imaging, sharp shutter cuts without halation, and allow for both hard and soft beam edges;
 - e. Unit shall operate at 100V to 240V 50/60 Hz and utilize an internal power supply;
 - f. Provide power lead with twistlock connector;
 - g. Unit shall support power and DMX in and thru connections.
 - h. Provide (1) 5-pin XLR terminator for every (5) fixtures
 - i. Provide the following quantity of lens tubes:
 - 1) (15) 19°; EDLT (or equivalent)
 - 2) (60) 26°; EDLT (or equivalent)
 - 3) (35) 36°; EDLT (or equivalent)
 - 4) (10) 50°; XDLT (or equivalent)
 - 5) (5) 15-30°; zoom type, EDLT (or equivalent)
 - j. Provide (1) 5-pin XLR terminator for every (5) fixtures
 - k. Quantity: (125)
 - l. Acceptable product:
 - 1) ETC ColorSource Spot V
 - 2) Var-Lite LED PLE
 - 3) Elation KL Profile FC
2. High Intensity Color-Changing LED Wash
 - a. Provide a six (6) color mixing high-intensity LED illuminator with DMX controlled intensity and color;
 - b. Unit shall have an accessory slot with a top-mounted quick release gel frame retainer.
 - c. Unit shall operate at 100V to 240V 50/60 Hz and utilize an internal power supply.
 - d. Provide power lead with twistlock connector;
 - e. Unit shall support power and DMX in and thru connections.
 - f. Provide one (1) NSP, MFL, and WFL round field lens with each fixture.
 - g. Provide with (6) barn door assemblies and floor-stand yokes with base.
 - h. Quantity (35)
 - i. Acceptable product:
 - 1) ETC Desire Fresnel
 - 2) Var-Lite CANTATA LED Fresnel FC
 - 3) Chauvet Ovation F-915FC
3. Intelligent Lighting Fixtures - LED Fixture
 - a. Unit shall be integrally designed, remote controlled motorized LED fixture.
 - b. Construction: the head, yoke, and enclosure shall be constructed of ABS plastic with fine textured black surface.
 - c. The fixture shall be a high-intensity white-light fixture with Cyan, Magenta, Yellow and CTO subtractive color mixing.
 - d. All LED moving light fixtures shall be provided by a single manufacturer to ensure compatibility.

- e. The fixture shall be UL 1573 listed for stage and studio use and comply with EN60598-2-17 standard per CE certification
- f. The fixture shall comply with the USITT DMX-512A standard
- g. The fixture output shall meet or exceed 9,000 field lumens
- h. CMY/CTO – Linear color mixing system
- i. Movement: Fixture shall have 540 degrees of pan and 270 degrees of tilt.
- j. Electrical: The fixture shall be equipped with a 100V to 240V 50/60Hz. Auto sensing internal power supply.
- k. Gobos: The fixture shall include at least (1) 6-position plus open rotating gobo wheel and (1) 6-position plus open static or rotating gobo wheel. Provide standard compliment with fixture.
- l. Power and control: Neutrik PowerCon input cable for power, plus XLR receptacle for DMX512 control; provide each fixture with 5-pin XLR converter cable.
- m. Provide with all required attachments and safety for mounting.
- n. Provide with (1) power pass-through cable and (1) 10' DMX cable for each fixture.
- o. Quantity: (8)
- p. Acceptable product(s):
 - 1) Vari-Lite 1600 Profile
 - 2) ETC Lonestar with Top Hat
 - 3) Chauvet Professional Silens 2X Profile
 - 4) Or approved equal.

D. Cables and Accessories

- 1. Extension Cables:
 - a. Provide extension cables for extending pigtail or wall box circuits to lighting instrument.
 - b. Provide cable and connectors which meet or exceed the quality of cables and connectors set forth in this specification.
 - c. Provide each cable with Velcro cable tie.
 - d. Provide extension cable assemblies consisting of 12-gauge, 3 conductor flexible cable and 20A rated male and female grounded twist-lock connectors.
 - e. Quantity:
 - 1) (15) @ 5 ft.
 - 2) (10) @ 10 ft.
 - 3) (3) @ 25 ft.
 - 4) (2) @ 50 ft.
 - f. Acceptable Products:
 - 1) TMB & Associates ProPower
 - 2) Lex Products PowerFLEX
 - 3) Or approved equal
- 2. Adapter Cables
 - a. Provide adapter cables for extending pigtail or wall box circuits to lighting instrument.
 - b. Provide cable and connectors which meet or exceed the quality of cables and connectors set forth in this specification.
 - c. Provide each cable with Velcro cable tie.
 - d. Provide extension cable assemblies consisting of 12-gauge, 3 conductor flexible cable and 20A rated male Edison connectors and female grounded twist-lock connectors.
 - e. Quantity:
 - 1) (10) @ 1ft. with Male Edison and female twist-lock connectors
 - 2) (10) @ 1ft. with Male twist-lock and female Edison connectors
 - 3) (10) @ 1ft. with Male Stage Pin and female twist-lock connectors
 - 4) (10) @ 1ft. with Male twist-lock and female Stage Pin connectors
 - f. Acceptable Products:

- 1) TMB & Associates ProPower
 - 2) Lex Products PowerFLEX
 - 3) Or approved equal
3. Two-fers:
- a. Provide “Y” cables to connect two fixtures to a single receptacle.
 - b. Provide cable and connectors, which meet or exceed the quality of cables and connectors set forth in this specification.
 - c. Provide adapter assemblies consisting of 12-gauge, 3 conductor flexible cable and connectors of same specifications found in this section.
 - d. Quantity: (10)
 - e. Acceptable Products:
 - 1) TMB & Associates ProPower
 - 2) Lex Products PowerFLEX
 - 3) Or approved equal
4. DMX-512 cable
- a. Provide DMX-512 cables for connecting lighting consoles, moving lights, or other DMX controlled accessories to the Network Nodes.
 - b. Connectors shall be Neutrik 5-pin.
 - c. Provide 24AWG two twisted pair data cable.
 - d. Insulation: polyethylene.
 - e. Nominal Impedance: 100 ohms.
 - f. Nominal Velocity of Prop.: 78%.
 - g. Capacitance between conductors: 12.5 pF/ft.
 - h. Quantity:
 - 1) (15) 5’ DMX Cable
 - 2) (10) 10’ DMX Cable
 - 3) (3) 25’ DMX Cable
 - 4) (2) 50’ DMX Cable
 - i. Acceptable Products:
 - 1) TMB & Associates ProPlex
 - 2) Lex Products PowerFLEX
 - 3) Or approved equal
5. Flexible Category 5e Cable/NET Cable:
- a. Provide extra rugged, flexible control cable (Ethernet) for connection of NET stations to portable Network Nodes.
 - b. Cable to be 4-pair, double shielded, low-capacitance.
 - c. Conductors: 24 AWG tinned, annealed copper stranded 7 x 0.16.
 - d. Connector: Provide with EtherCon connector by Neutrik
 - e. Assembly: pairs cabled with Kevlar strength member.
 - f. Shield: (inner) aluminum/Mylar, 100% coverage (outer) tinned copper braid, 80% coverage.
 - g. Conductivity: 15ohms per 100 meters @ 20C.
 - h. Impedance: 100 ±15 ohms 1-100 MHz
 - i. Quantity:
 - 1) (5) 3’ Ethernet Cable
 - 2) (5) 10’ Ethernet Cable
 - 3) (2) 25’ Ethernet Cable
 - 4) (1) 50’ Ethernet Cable
 - j. Acceptable Products:
 - 1) TMB & Associates ProPlex
 - 2) Lex Products PowerFLEX
 - 3) Or approved equal
6. XLR DMX Terminator
- a. Provide XLR DMX male terminator
 - b. Connector shall be Neutrik 5-pin.

- c. Termination resistance: 120 ohms +/- 10% between pins 2 and 3
 - d. Termination power capacity: 2 watts
 - e. Quantity: (6)
 - f. Acceptable Product
 - 1) ETC SGE 1507
 - 2) Lex Products DMX5P-TERM
7. Color Medium Sheets
- a. Provide standard and high temperature (HT) color medium
 - b. Color medium shall be selected by Owner
 - c. Provide (24) full size sheets (20"x24") of HT color filter
 - d. Acceptable product(s):
 - 1) Lee Color Filters
 - 2) Rosco Color Filters
8. Pattern Templates (Gobos)
- a. Provide eight (8) stainless steel image patterns.
 - b. Size and patterns shall be selected by the Owner.
 - c. Acceptable product(s):
 - 1) Rosco Stainless Steel Gobos
9. Pattern Template Holders
- a. Provide stainless steel metal pattern holders with plastic pull ring
 - b. Quantity:
 - 1) (8) size A
 - 2) (8) size B
 - c. Acceptable product(s):
 - 1) City Theatrical 2150 and 2160 sandwich holders
 - 2) Electronic Theatre Controls 400PH-A and 400PH-B pattern holders
10. Side Arm Extensions
- a. Provide side arms for extending the mounting point of theatrical fixtures beyond rigging pipes and handrails.
 - b. Side arm to consist of:
 - c. Hanging attachment for connection to 1.5" schedule 40 batten, handrail, or tension wire grid hanger.
 - d. Pipe extension of 24" long
 - e. One or more sliding tees for attaching theatrical fixtures to pipe extension
 - f. Color: black
 - g. Quantity: (24)
 - h. Acceptable product:
 - 1) Altman Lighting 509-HD-24-1 Side Arm
 - 2) City Theatrical Steel Safer Side Arm 210
11. Tie Line
- a. Product will be a cotton line with polyester core
 - b. The blend will be a diamond braid construction
 - c. Product will be Black in color
 - d. Product will be unglazed
 - e. Product will be 1/8" in diameter
 - f. Product will be on original spool or reel
 - g. Provide 600'-0" spool
 - 1) Cut into 24" ties for dressing cable used in repertory plot
 - 2) Furnish the remainder of unused spool to Owner
 - h. Acceptable product:
 - 1) Rose Brand #4 Tie Line
12. Lighting Fixture Storage Racks
- a. Provide rolling rack for fixture storage.
 - b. Rack will have a top and bottom storage shelf.
 - c. All finishes will be black.

- d. Rack will have heavy-duty ridged and locking swivel casters.
 - e. Rack shall have adjustable storage pipes with steel pin retainers to accommodate various fixtures.
 - f. Provide with (2) multi-cable storage brackets with each rack.
 - g. Size: Ensure product size will fit within the project elevator. Assumed elevator size will allow for 3' x 6' cart
 - h. Quantity: (2)
 - i. Acceptable product(s)
 - 1) SSRC Fixture Carts
 - 2) Or approved equal
13. Light Trees:
- a. Provide code rated parts to comprise a lighting tree.
 - b. Pipe and base will be furnished in black finish.
 - c. Provide six (6) light tree assemblies as follows:
 - d. Provide a 50lb. base NPT threaded to accept a typical 1-1/2" Schedule 40 pipe.
 - e. Provide a 10'-6" section of 1-1/2" Schedule 40 pipe (threaded on both ends) with plastic vinyl end cap.
 - f. Provide total eight (8) – 18" sliding tee side arms for each tree.
 - g. Provide total three (3) – 35 pound sandbags for each tree.
 - h. Acceptable product:
 - 1) Base: Altman B50.
 - 2) Or approved equal
 - 3) Provide with storage cart
- 14.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final product.
- B. The installation recommendations contained within the Telecommunications Distribution Methods Manual are mandatory minimum standards and requirements.
- C. Mount equipment and enclosures plumb and level.
- D. Permanently installed equipment to be firmly and safely held in place.
- E. Verify all locations of equipment in all rooms with Owner's Representative, Owner, and Consultant.

3.2 INSTALLATION OF CABLE AND WIRING

- A. Verify installation of electrical work for this scope and all associated equipment with the overall Electrical installation. Provide all necessary equipment, including mounting hardware, for complete connection of power system wiring.
- B. Verify installation of power and ground wiring to equipment. Power and ground wiring will terminate inside of equipment and/or junction boxes and be hardwired to ground buss and circuit breaker to ensure uninterrupted operation.
- C. All control wiring will be executed in adherence to ANSI standards including the following:
 - 1. Isolate cables carrying signals at different levels and separate to restrict interaction.

2. Keep wiring separated into three groups of conduit provided for control circuits, power circuits (up to 50 Amps), and feeder circuits (above 50 Amps).
3. Isolate all wiring, except for safety ground wiring, from conduit ground.
4. Take such precautions as are necessary to prevent and guard against electromagnetic and electrostatic interference in other technical systems (such as sound and communications systems) in the facility. Where possible all devices and wiring will be enclosed in a shielded environment. Take care not to use shields (conduits) and grounds as current carrying return paths for lamp and relay coil commons. All ground references are to be made to the building electrical system ground.
5. Label unused wiring provided for spares or future systems and terminate at screw terminal strips.
6. All joints and connections will be made with resin-core solder or with ratchet jaw crimp type mechanical connectors. Connect all circuits electrically in phase using same wire color code for similar circuits throughout the project.
7. Install cable in a manner to adhere to manufacturer's specifications for maximum cable pulling tension, minimum bend radius, and restrictions.
8. Provide appropriate support at all horizontal-to-vertical transitions in order to keep the weight of the cable from degrading at the point of transition.
9. If a J-hook or trapeze system is used to support cable bundles, all horizontal cables shall be supported at a maximum of 48-inch (1.2 meter) intervals. At no point shall the cables rest on light fixtures, acoustic ceiling grids, panels, conduits, sprinkler pipe, water pipe and/or HVAC system ducting.
10. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices
11. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, install appropriate carriers to support the cabling.
12. Cables shall be identified by a self-adhesive machine label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606-A. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
13. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
14. Provide splice free wiring and cabling from origination to destination. Cables shall be installed in continuous lengths from origin to destination (no splices). Properly designed transition points, or consolidation points are not considered 'splice' points.
15. Cover edges of cable and wire pass-through holes in chassis, housings, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.
16. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced prior to final acceptance at no cost to the Owner.

3.3 INSTALLATION OF EQUIPMENT

- A. Take appropriate precautions against electrostatic discharge (ESD) when installing electronic equipment.
- B. Equipment to be installed in new condition, free of damages, scratches, dents, etc.
- C. Provide adequate ventilation in cabinet mounted equipment to maintain operating temperatures within range recommended by Manufacturer.
- D. All equipment will be installed in compliance with applicable Local and National Codes and Regulations.

- E. Equipment shall be installed in accordance with Manufacturer's requirements.
- F. Install lighting fixtures using standard industry practices. All lamps, lenses, and reflectors will be installed free of dirt, dust, and finger smudges. Do not use bare hands when handling conventional tungsten lamps. Ensure that a safety cable is properly applied with each fixture.
- G. Install lighting instruments to the standard house hang or repertory plot as directed by Consultant. Contractor shall document location of each type of distribution device and circuiting as part of as-built documents on plot. Provide pdf copy of plot to Consultant and Owner. Provide (2) full size printed copies of plot to Owner.

3.4 CONTRACTOR COMMISSIONING

- A. Prior to energizing or testing the System ensure the following:
 - 1. Physical installation is complete.
 - 2. Products are installed in proper and safe manner according to Manufacturer's requirements.
 - 3. Dust, debris, solder splatter, etc. is removed.
 - 4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
 - 5. Temporary facilities and utilities have been properly disconnected and removed.
 - 6. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded. The jobsite shall be broom clean.
- B. Contractor shall:
 - 1. Retain the services of a Manufacturer certified technician to check the installation and ensure its proper operation. No part of the Theatrical Lighting System may be energized before this technician has checked and approved the System installation.
 - 2. Test all lighting load circuits for the following:
 - a. Continuity
 - b. Nominal voltage
 - c. Polarity
 - d. Accuracy to the Distribution Schedule as enumerated in the drawings.
 - 3. Test controls wiring for the following:
 - a. Appropriate wire types and quantities
 - b. Control wire distance from source
 - c. Terminations meet Manufacturer requirements
- C. The following identifies some, but not all, of the commissioning tasks of the commissioning team. This list is not intended to be comprehensive and should be considered a general guideline for the Contractor without a defined commissioning process statement:
 - 1. Program all power distribution panels
 - 2. Setup and program all network control devices
 - 3. Setup and initial programming of control console
 - 4. Setup and initial programming for all architectural control devices
 - 5. Program all emergency lighting control devices

3.5 FINAL OBSERVATION & TESTING

- A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final inspection and test will be observed by the Consultant.
- B. Testing will include operation of each major system and any other components deemed necessary. Contractor will assist in this testing and provide all test equipment noted

below. Contractor shall provide at least two (2) technicians available for the entire testing period (day and night), to assist in tests, adjustments, and final modifications. Testing process is estimated to take a minimum of one (1) day.

- C. Provide the following test gear:
 - 1. Circuit Tester with adapters for all connectors present in the system.
 - 2. Multimeter capable of measurements up to 600V AC/DC, 10A DC, and 2MOhms
 - 3. DMX Tester
 - 4. Industrial Ethernet Tool capable of testing signal continuity and distance from source

- D. The following procedures will be performed on each System:
 - 1. Observation of the physical installation including labeling, mounting, and finish of all equipment and components which are a part of the System.
 - 2. Functional testing of all control devices and devices under control within the System.
 - 3. Review of programming and standard settings for all control interface devices.
 - 4. Load circuit verification.
 - 5. Control circuit verification.
 - 6. Other tests on equipment or systems deemed appropriate.

- E. The Consultant will provide the Owner with a listing describing any incomplete or otherwise deficient items determined as part of the testing process. Where further adjustment or work becomes evident during testing, the Contractor is to continue work until the System is complete.

3.6 INSTRUCTION OF OWNER PERSONNEL

- A. Provide operations and service training on all equipment incorporated in the System.

- B. Training shall not be conducted until final observation and testing is completed by the Consultant, unless otherwise directed by the Owner.

- C. Provide (16) hours of training. Training time shall be conducted in multiple sessions, with each session not to exceed four hours. Training shall be conducted in accordance with Owner's schedule.
 - 1. Six months after completion of initial training, schedule an additional (4) hours with Owner for review of systems and equipment operation.

- D. The major equipment components and subject matter are as follows (advisory percentage of overall time allocated):
 - 1. Power Distribution System (20%)
 - a. Basic testing and control
 - b. Normal and emergency operations
 - c. Programming memory
 - d. Software configurations and upgrades
 - e. Troubleshooting.
 - 2. Control Console (40%)
 - a. Operational training, including offline or remote-access software
 - b. Patching and programming
 - c. Fixture integration
 - d. Peripheral hardware
 - e. Applications interface for retrieving information from the control console
 - f. Troubleshooting
 - g. Upgrades
 - 3. Architectural Controls (20%)

- a. Part of training will be to establish programmed looks for the performance areas with the end-user. The Contractor shall provide all equipment to establish DMX values for preset looks.
 - b. Snapshotting preset onto DMX controller
 - c. Preset recall operation
 - d. Normal operations (e.g., console arbitration, time-clock controlled events, etc.)
 - e. Troubleshooting.
4. Theatrical Lighting Fixtures and Accessories (20%)
- a. Hang and focus
 - b. Cabling and circuiting
 - c. Setup and DMX addressing
 - d. Troubleshooting
- E. Training Schedules
1. Training should be assumed to take place on the project site.
 2. Training should be scheduled to be non-overlapping.
 3. Actual training schedule shall be by agreement with Owner.
 4. In the event that a portion of the training time is occupied in troubleshooting the equipment installation, then the training time shall be extended an equal amount of time.
- F. Submit an outline of the course with sample instructional aides for approval thirty (30) days prior to scheduled instruction sessions to architect and architect's consultant.
- G. Following discussions with Owner, provide a Training submittal 2-4 weeks prior to first training. Submittal shall:
1. Include a separate page/entry for every training session.
 2. Indicate date, time, and approximate length of training session.
 3. Indicate person(s) conducting training.
 4. Indicate whether training will be video recorded.
 5. Intended curriculum and most appropriate attendees (e.g., technician, operations, IT, etc.)
 6. Include signature and title lines for:
 - a. Owner acknowledging and accepting training schedule. Include both an Accepted and Rejected box. An alternate schedule time should be suggested by the Owner in the event the schedule is rejected.
 - b. Countersigning by trainer indicating that training actually occurred.
 - c. All persons attending training. Where attendees do not stay for the entire session, this should be noted on the form and initialed by Owner's representative attending training.
 - d. Owner's representative attending training at the end of the session shall initial that:
 - 1) Training Occurred.
 - 2) Training Materials were provided and left with Owner
 - 3) Training was not interrupted or shortened by equipment or system troubleshooting. If it is, then there should be a line where Owner and Contractor can indicate when make-up training will be provided and how long it should be.
 - 4) Training was generally sufficient for the proposed curriculum.
 7. Include Notes section for Owner and Contractor to note any issues during training (areas requiring further development, etc.)
- H. Following training occurrence, submit completed training records no later than 5 days following end of training. When training is conducted over a period of weeks, completed training submittals shall be consolidated into a single submittal and submitted every 2 weeks.

3.7 EVENT ATTENDANCE

- A. Contractor shall attend the first facility use or event as directed by the Owner.
 - 1. Event Attendance includes the following requirements:
 - a. Attendance shall begin at the first crew call and conclude when the crew is released. During these events perform such tasks (e.g., assistance with patching, programming, troubleshooting cabling problems, etc.) as requested by User. Tasks shall be strictly assistance, not operation.
 - b. Event support personnel shall be a technician associated with the original installation and commissioning.
 - c. In the event that the system is used prior to final acceptance, attendance in support of system usage shall not be construed as acceptance or as event attendance.
 - 2. Coordinate these schedules with the Owner.

END OF SECTION 11 61 62

SECTION 12 22 00 - CURTAINS AND DRAPES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Draperies.
- B. Formed steel track.
- C. Extruded aluminum track.
- D. Nylon carriers, cords, and accessories.
- E. Motorized carrier device.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 83 - Wiring Connections: Wiring from control station to operator.

1.3 PRICE AND PAYMENT PROCEDURES

- A. See section 01 21 00 - Allowances, for cash allowances affecting this section.
- B. Allowance includes purchase and delivery of drapery track. Installation is not included in the allowance but is specified in this section and is included in the Contract Sum/Price.
- C. Allowance includes purchase, delivery, and installation of drapery track and anchors.

1.4 REFERENCE STANDARDS

- A. NEMA MG 1 - Motors and Generators; 2021.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate location and installation of concealed blocking for support of tracks.

1.6 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide track profiles, acceptable load data, finishes available, and electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate end track location, width of window opening, location of blocking for anchors, appurtenances and interferences, adjacent construction, operating hardware, and support bracket details.
- D. Manufacturer's Installation Instructions: Indicate procedures, perimeter conditions requiring attention, and _____.
- E. Maintenance Data: Include data for motor, shaft and gearing, lubrication frequency, control adjustments, spare part sources.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Carriers: Quantity equal to 5 percent of those installed.
 - 3. Extra Control Cords/Wands: Two of each type installed.

1.7 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this section, with minimum three years of documented experience.

1.8 MOCK-UP

- A. Provide _____ mock-up, _____ feet (_____ m) long by _____ feet (_____ m) wide, drapery track as an integral part of a window and ceiling intersection assembly.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Drapery Track:
 1. Kirsch, Inc; _____: www.kirsch.com/#sle.
 2. SWFcontract, a division of Springs Window Fashions, LLC; _____: www.swfcontract.com/#sle.
 3. _____.
 4. _____.
 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

- A. Tracks: Formed steel, bi-parting operating traverse rods, regular duty channel track.
- B. Track Brackets: Formed steel wall type, for recessed installation, with screws and inserts for attachment.
- C. Carriers: Nylon roller 3 per foot (10 per m), _____ type.
- D. Cord: Braided nylon; continuous loop, free end weighted, complying with WCMA A100.1.
- E. Control Wand: Extruded hollow plastic; square shape; non-removable type; length of window opening height less 3 inches (75 mm).
- F. Track Enclosure: Pre-finished, formed aluminum box; internally fitted with hardware for operation.
- G. Tension Pulley: Nylon rollers in metal retainer, fixed with spring loaded tension wall bracket.

2.3 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics:
 1. _____ hp (_____ kW).
 2. _____ volts, single phase, 60 Hz.
 3. _____ amperes maximum fuse size.
 4. _____ percent minimum power factor at rated load.
 5. Refer to Section 26 05 83.
- B. Motor: NEMA MG 1, _____.
- C. Control Station: Three button, open-close-stop, momentary type, control for each electric operator; surface mounted, switch located at _____.
- D. Remote Control: Hand held transmitter; digital control, resettable.
- E. Electric Operator: Center mounted, adjustable friction clutch, enclosed limit switch; mounting brackets and hardware; manually operable in case of power failure; transit time of _____ inches (_____ mm) per second.
- F. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
- G. Disconnect Switch: Factory mount disconnect switch in control panel.

2.4 FINISHES

- A. Exposed Surfaces: Baked enamel, white.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that concealed anchors are in correct position.
- B. Verify that electrical service is correctly located and of proper characteristics.

3.2 INSTALLATION

- A. Install drapery tracks in accordance with manufacturer's instructions.
- B. Extend track 12 inches (300 mm) both sides with window trim for single track; 18 inches (450 mm) for double track where exposed.
- C. Mount track and motor support brackets on solid backing. Where mounting location does not align with solid backing, provide expanding anchors for each screw hole location.
- D. Anchor tension pulley to wall.
- E. Set cord pulls so that cord pull is 12 inches (300 mm) below window sill in full open position.

3.3 ADJUSTING

- A. Adjust drapery hardware for smooth operation.

3.4 SCHEDULES

- A. _____: _____.

END OF SECTION

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SECTION 12 24 00 - WINDOW SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior manual roller shades.
- B. Accessories as required vor complete installation.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.3 REFERENCE STANDARDS

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015 (Reapproved 2021)e1.
- B. C2C (DIR) - C2C Certified Products Registry; Cradle to Cradle Products Innovation Institute; Current Edition.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.
- E. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.
- F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.
- G. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.
- B. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb, and sill details, mounting dimension requirements for each product and condition, and operation direction.
- D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.
- E. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.
- F. Selection Samples: Include fabric samples in full range of available colors and patterns.
 - 1. Motorized Shades: Include finish selections for controls.
- G. Verification Samples: Minimum size 6 inches (150 mm) square, representing actual materials, color and pattern.

- H. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- I. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.
- J. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- K. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- L. Maintenance contracts.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this type with minimum 5 years of documented experience with shading systems of similar size and type.
 - 1. Manufacturer's authorized representative.
 - 2. Factory training and demonstrated experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

1.8 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 WARRANTY

- A. Refer to Section 01 77 00 - Closeout Procedures for additional warranty requirements.
- B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 - 1. Shade Hardware: One year.
 - 2. Fabric: One year.
 - 3. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 - 1. Interior Manually Operated Roller Shades:
 - a. Draper, Inc: www.draperinc.com/#sle.

2.2 ROLLER SHADES

- A. General:
 - 1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
 - 2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Interior Shades:

1. General Requirements:
 - a. Roll Direction: Roll down, closed position is at window sill, unless noted otherwise.
 - b. Mounting: As indicated on Drawings.
 - c. Roller Tubes:
 - 1) Material: Extruded aluminum.
 - 2) Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - 3) Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
 - 4) Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.
 - d. Drop Position: Regular roll.
 - e. Double-Roller Drop Position:
 - 1) Light-Filtering Fabric: Room-side of opening.
 - 2) Room-Darkening Fabric: Glass-side of opening.
2. Manually-Operated Shades:
 - a. Basis of Design: Clutch-operated Flexshade NEXD manufactured by Draper
 - b. Description: Manually operated fabric window shades for both light-filtering and room-darkening as indicated on Drawings.

2.3 ROOM-DARKENING FABRIC

- A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 1. Manufacturers:
 - a. Specifications are based on the products identified as Basis of Design. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
 2. Basis of Design:
 - a. SheerWave Style SW7100 manufactured by Draper.
 3. Material: Per product designation.
 4. Performance Requirements:
 - a. Flammability: Pass NFPA 701 large and small tests.
 - b. Fungal Resistance: No growth when tested according to ASTM G21.
 5. Color: P04 White/Bone.
 6. Fabrication:
 - a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
 - b. If height of opening requires multiple panels of railroaded fabric, use battens at seams.
 - c. Battens: Full width of shade, enclose in welded shade fabric pocket.

2.4 SHADE FABRIC

- A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 1. Manufacturers:
 - a. Lutron Electronics Co., Inc: www.lutron.com/#sle.
 - b. MechoShade Systems LLC: www.mechoshade.com/#sle.
 - c. Mermet Corporation: www.mermetusa.com/#sle.
 - d. Phifer, Inc: www.phifer.com/#sle.

- e. Substitutions: See Section 01 60 00 - Product Requirements.
- 2. Basis of Design:
 - a. E Screen ME0220 by Draper.
- 3. Material: Per product Designation.
- 4. Material Certificates and Product Disclosures:
 - a. Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
 - b. Cradle to Cradle Material Health Certificate: Achievement level of Bronze.
 - c. Health Product Declaration (HPD): Complete, published declaration with full disclosure of known hazards.
 - d. Declare label.
- 5. Performance Requirements:
 - a. Flammability: Pass NFPA 701 large and small tests.
 - b. Fungal Resistance: No growth when tested according to ASTM G21.
- 6. Openness Factor: 3%.
- 7. Roll Width: 72 inches (1829 mm).
- 8. Color: White/Linen.
- 9. Fabrication:
 - a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
 - b. If height of opening requires multiple panels of railroaded fabric, use battens at seams.
 - c. Battens: Full width of shade, enclose in welded shade fabric pocket.

2.5 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: As recommended in writing by manufacturer.
- C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Start of installation shall be considered acceptance of substrates.

3.2 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.4 SYSTEM STARTUP

- A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

3.5 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.
- C. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.
- D. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours training by manufacturer's authorized personnel at location designated by the Owner.

3.7 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

3.8 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner, a proposal as an alternate to the base bid, a separate renewable maintenance contract for the service and maintenance of a motorized shade system for one year from date of Substantial Completion. Include a complete description of preventive maintenance, systematic examination, adjustment, parts and labor, cleaning, and testing, with a detailed schedule.

END OF SECTION

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SECTION 12 36 00 - COUNTERTOPS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Countertops for architectural cabinet work.
 - 2. Countertop supports.
- B. Related Sections:
 - 1. Section 11 53 13 - Laboratory Fume Hoods: Work surfaces inside fume hoods.
 - 2. Section 12 35 53.19 - Wood Laboratory Casework: Laboratory countertops.
 - 3. Section 22 40 00 - Plumbing Fixtures: Sinks.

1.3 PRICE AND PAYMENT PROCEDURES

- A. Refer to Section 01 21 00 - Allowances, for cash allowances affecting this section.
- B. Refer to Section 01 23 00 - Alternates, for product alternates affecting this section.

1.4 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- E. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- G. AWI (QCP) - Quality Certification Program; Current Edition.
- H. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- I. AWMAC (GIS) - Guarantee and Inspection Services Program; Current Edition.
- J. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- K. IAPMO Z124 - Plastic Plumbing Fixtures; 2022.
- L. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- M. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
- N. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- O. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.
- P. NSF 51 - Food Equipment Materials; 2023.
- Q. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.
- R. PS 1 - Structural Plywood; 2023.
- S. SEFA 2 - Installations; 2010.

- T. SEFA 3 - Laboratory Work Surfaces; 2020.
- U. WI (CCP) - Certified Compliance Program (CCP); Current Edition.
- V. WI (CSIP) - Certified Seismic Installation Program (CSIP); Current Edition.
- W. WI (MCP) - Monitored Compliance Program (MCP); Current Edition.

1.5 PERFORMANCE REQUIREMENTS

- A. Countertops and Vanities: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops and vanities:
 - 1. All deadloads.
 - 2. 500 pound live load placed on the countertop and vanity.
 - 3. Deflection at Midspan: L/1000 times span or 1/8 inch whichever is less.

1.6 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
- F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- G. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- H. NSI Fabricator Qualification: Documentation of Natural Stone Institute Accreditation.
- I. Installer's qualification statement.
- J. Installation Instructions: Manufacturer's installation instructions and recommendations.
- K. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Natural Stone Institute (NSI) Accredited Natural Stone Fabricator; www.naturalstoneinstitute.org/#sle.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- C. Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
 - a. This AWI (QCP) project is registered as project number _____.
 - 2. Comply with AWMAC (GIS) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 3. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.woodworkinstitute.com/#sle.

4. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
5. Provide designated labels on shop drawings as required by certification program.
6. Provide designated labels on installed products as required by certification program.
7. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.9 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

- A. Warranty the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
- B. Defects shall include but not be limited to the following:
 1. Rough or difficult operation, or loose or missing parts.
 2. Delamination of surfaces.
 3. Noticeable deterioration of finish.
 4. Warped or misaligned surfaces or telegraphing of subsurface imperfections.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers listed whose products meet or exceed the specifications are approved for use in the Work. Other manufacturers must have a minimum of five (5) years' experience manufacturing products meeting or exceeding the specifications and comply with Division 01 requirements regarding substitutions to be considered.
- B. Substitutions: Refer to Section 01 25 13 - Product Substitution Procedures.

2.2 COUNTERTOPS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Quality Standard: SEFA 3 for laboratory worksurfaces.
- C. Natural Stone Countertops: Stone slabs bonded to substrate; use as large pieces as possible with inconspicuous adhesive joints.
 1. Manufacturers:
 - a. Cosentino
 2. Stone: Granite without cracks, voids, or pin holes; filling with matching epoxy resin is acceptable.
 3. Color: White Macaubas.
 4. Quarry Name: Matching Architect's sample; substitutions will be considered under provisions of Section 01 60 00.
 5. Stone Thickness: 1/2 inch (12 mm), minimum.
 6. Surface Finish: Polished.
 7. Surface Sealer: High gloss water-based acrylic, transparent.

8. Surface Protection: Polyester protective film.
 9. Edge: As indicated on Drawings.
 10. Back and End Splashes: Same material, same thickness; for field attachment.
 11. Fabricate in accordance with manufacturer's standard requirements.
- D. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
1. Flat Sheet Thickness: 1-1/4 inch (32 mm), minimum.
 2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard stone fabrication tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Cambria Company LLC: www.cambriausa.com/#sle.
 - 2) Dal-Tile Corporation: www.daltile.com/#sle.
 - 3) LG Hausys America, Inc; Viatera 3cm: www.lghausysusa.com/#sle.
 - 4) Seieffe Corporation; OKITE®: www.okite.us/#sle.
 - 5) Terrazzo & Marble Supply Companies; DIFINITI Quartz: www.tmsupply.com/#sle.
 - 6) Terrazzo & Marble Supply Companies; Diresco Belgium Quartz, a brand of Diresco - North America: www.tmsupply.com/#sle.
 - 7) Wilsonart: www.wilsonart.com/#sle.
 - b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with NSI (DSDM).
 - c. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - d. NSF approved for food contact.
 - e. Color and Pattern:
 - 1) QRC-1:
 - (a) Color: Viatera / Snow White.
 - (b) Finish: Polished.
 - 2) QRD-2:
 - (a) Color: Viatera / Carbo Brushed.
 - (b) Finish: Brushed.
 3. Other Components Thickness: 3/4 inch (19 mm), minimum.
 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch (32 mm) thick; eased edge.
 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
 6. Skirts: As indicated on drawings.
 7. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
 8. Fabricate in accordance with manufacturer's standard requirements.

2.3 ACCESSORIES

- A. Countertop and Vanity Supports:
1. Custom Fabricated Countertop and Vanity Framing:
 - a. Material: Steel
 - b. Fabrication: Fabricate countertop and vanity framing, using steel shapes and plates, and cold finished mild steel bars at exposed conditions, for support framing and plywood, to the thicknesses, sizes and shapes shown, and as required to produce work of adequate strength and durability, without objectionable deflections. Use proven details of fabrication, as required, to achieve proper assembly and alignment of the various components of the work.

- c. Finish: Powder Coat.
 - 1) Color: Black.
2. Pre-Fabricated Countertop and Vanity Supports:
 - a. Material: Aluminum.
 - b. Finish: Powder Coat.
 - 1) Color: Off-White.
 - c. Basis of Design: Rakks EH manufactured by Rangine Corporation.
3. Pre-Fabricated Countertop Support:
 - a. Basis of Design: Front Mounting Plus manufactured by Centerline Brackets.
 - b. Material: 3/8 by 2-1/2 inch steel.
 - c. Bracket Depth and Height: As recommended by manufacturer.
 - d. Finish: Powder Coat.
 - 1) Color: Black.

2.4 MATERIALS

- A. Wood-Based Components:
 1. Wood fabricated from old growth timber is not permitted.
 2. Provide sustainably harvested wood, certified or labeled; refer to Section 01 60 00 - Product Requirements.
 3. Provide wood harvested within a 500 mile (805 km) radius of the project site.
 4. Wood fabricated from timber recovered from riverbeds or otherwise abandoned is permitted, unless otherwise noted, provided it is clean and free of contamination; identify source; provide lumber re-graded by an inspection service accredited by the American Lumber Standard Committee, Inc.
- B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- C. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf (20 kg/cu m) minimum density; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- D. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
- E. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- F. Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch (12 mm) by 1/2 inch (12 mm).
 1. Color: As indicated on drawings.
 2. Color: As selected by Architect from manufacturer's full line.
- G. Joint Sealant: Mildew-resistant silicone sealant, white.
- H. Polyester Protective Film: Scratch-, heat-, and acid-resistant optically clear removable polyester film for bonding to stone counters.
 1. Thickness: 4 mil, 0.004 inch (0.1 mm), minimum.
 2. Finish: Gloss.
 3. Construction: Multi-ply laminate.
 4. Adhesive Type: Pressure sensitive acrylic.
 5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84 (Class A).
 6. NSF approved for food contact per NSF 51.
 7. Products:
 - a. Stoneguard USA: www.stoneguardusa.com/#sle.
 - b. Surface Shields, Inc: www.surfaceshields.com/#sle.
 - c. TuffSkin Surface Protection LLC; TuffSkin: www.tuffskin.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

- I. Sealer: Stain and acid protection for natural stone counters.
 1. NSF approved for food contact per NSF 51.
 2. Products:
 - a. Custom Building Products: www.custombuildingproducts.com/#sle.
 - b. Rockstar Sealing, a division of TuffSkin Surface Protection LLC; Natural Finish Stone Sealer: www.rockstarsealing.com/#sle.
 - c. STONETECH, a division of LATICRETE International, Inc: www.laticrete.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.5 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 1. Join lengths of tops using best method recommended by manufacturer.
 2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
 - a. Rout a 1/8 inch (3 mm) drip groove at underside of exposed overlapping edges, set back 1/2 inch (13 mm) from face of edge.
 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash where indicated on Drawings.
 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 2. Height: 4 inches (102 mm), unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install vanities in accordance with manufacturer's instructions and approved shop drawings
- B. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- C. Apply sealer products in accordance with manufacturer's written instructions.
- D. Apply polyester protective film in accordance with manufacturer's instructions.
- E. Seal joint between back/end splashes and vertical surfaces.
 1. Where indicated use rubber cove molding.
 2. Where applied cove molding is not indicated use specified sealant.

3.4 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.
- B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.
- C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.5 CLEANING

- A. Clean countertops surfaces thoroughly.

3.6 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM
- C. SECTION 21 05 48 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- D. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- E. SECTION 21 11 13 – FIRE SUPPRESSION SYSTEMS.
- F. SECTION 21 13 39 - FOAM-WATER SYSTEMS
- G. SECTION 21 22 00 - CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS.
- H. SECTION 21 30 00 - FIRE PUMPS AND EQUIPMENT
- I. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 SUMMARY

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested and performing their intended function.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. Phased Construction:
 - 1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the buildings and mechanical, plumbing and fire protection systems that must remain operational.
 - 2. Contractor shall include any and all temporary services required to keep the Owner occupied portions of the buildings operation without interruption of HVAC, plumbing and fire protection services for the duration of the project.
 - 3. Refer to Architectural drawings for description of phasing, stage all mechanical, plumbing and fire protection work accordingly.

- D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

1.3 QUALITY ASSURANCE

- A. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas.
- B. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- C. All materials and distribution, and utilization equipment shall be UL Listed.
- D. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- E. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner

1.4 QUALIFICATION OF CONTRACTORS

- A. The Contractor for the fire protection installation shall be a certified fire protection contractor, licensed for the installation of automatic fire sprinkler systems and other fire protection equipment.
- B. An approved contractor for the work under this division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
 - 2. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas
 - 3. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

1.5 DESIGN STANDARDS

- A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:
 - 1. The International Fire Prevention Code
 - 2. The International Building Code
 - 3. National Fire Protection Association (NFPA) Standards:
 - a. NFPA 101 - Life Safety Code
 - b. NFPA 13 - Installation of Sprinkler Systems
 - c. NFPA 14 - Installation of Standpipe and Hose Systems
 - d. NFPA 20 - Installation of Centrifugal Fire Pumps
 - e. NFPA 24 - Installation of Private Fire Service Mains

- f. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems
 - g. NFPA-2001 – Standard for Clean Agent Fire Extinguishing Systems
- B. Factory Mutual (FM) Approval Guide
 - C. Underwriters Laboratories Inc. (UL)
 - D. Owner's Insurance Underwriter Requirements

1.6 GENERAL REQUIREMENTS

- A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.
- D. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 00 00 - Mechanical General.

1.7 WORK INCLUDED

- A. Code compliance, research, design coordination, and installation or a complete and functional hydraulically calculated wet pipe sprinkler system that meets the approval, and is in accordance with the requirements of NFPA Fire Protection Standards listed in 1.4 (a), Underwriters Laboratory (UL), all local and state regulations, and these specifications.
- B. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.
- C. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.
- D. All permits and approvals of the fire protection system.
- E. SYSTEMS: Plumbing Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to, the following as noted below. The connection point for all systems from the site utilities shall be as 5'-0" from the exterior of the building unless specifically otherwise noted.
 - 1. Access Panels
 - 2. Floor, Wall, and Ceiling Plates
 - 3. Insulation

4. Heatrace
5. Piping and Equipment Identification
6. Painting

1.8 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.
- F. The mechanical trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment specified and scheduled on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.9 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.
- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.
- D. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the Architect of the discrepancy for resolution.
- E. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.10 ORDINANCES, PERMITS AND DRAWING APPROVALS

- A. The Contractor shall file all requisite plans relating to this section of the specifications with the proper authorities, secure all permits and approvals and pay all resultant fees for work done under this section.

- B. All fire protection work shall comply with all laws, ordinances, rules, regulations and standards of the City, County, State and the Owner's Insurance Underwriter; all applicable sections of the National Fire Codes and the Codes and Standards of the National Fire Protection Association.
- C. If code or other requirements exceed the provisions shown on the Contract Documents, the Architect shall be notified in writing. Where requirements of the Contract Documents exceed Code requirements, work shall be furnished and installed in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

1.11 SUBSTITUTIONS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. See division 01 specification for additional requirements.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **seven (7)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- D. **No substitutions will be considered after the Award of Contract.**
- E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
 - 1. Product data, drawings and descriptions of products, fabrication and installation procedures.
 - 2. Samples, where applicable or requested.
 - 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
 - 4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 - 5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.

6. Cost information, including a proposal of the net change, if any in the Contract Sum.
 7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
 8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution
- F. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

1.12 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8 inch scale or larger, one drawing per building area. Provide 1/4 inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
 1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnished product named in Specification and or Drawings.
 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.

- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.
- F. All approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to equipment being submitted to the Engineer.
- G. Review of submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.
- H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.
- I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

1.13 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.14 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.15 EXISTING CONDITIONS

- A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.
- B. Outages of services are required by the new installation will only be permitted at a time approved by the Owner. The contractor shall allow the Owner a 2 week window in order to schedule required outages. The time allowed for outages will not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.
- C. Work Sequence, Timing, Coordination with Owner:

1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.
- D. Demolition and Work within Existing Buildings:
1. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing piping, duct, equipment and other apparatus related to this phase of the work. However, the Contractor shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the facilities and related areas. The Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by his contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be part of this Contract.
 2. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.
 3. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including associated system connections. Where duct or pipe is to be capped for future extension or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric connection, the Electrical Contractor shall disconnect equipment and remove wiring back to panel or disconnect switch. Contractor shall remove or relocate equipment and associated disconnect.
 4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades separating work area from occupied areas.
 5. Certain work during the demolition and construction phases of construction may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation with the Project Administrator at least seventy-two (72) hours in advance in writing.
 6. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.
 7. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.
 8. Make every effort to minimize damage to the existing building and the owner's property. Repair, patch or replace as required any damage which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to

- a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.
9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment and plumbing fixtures as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, ventilation and plumbing services for the existing areas.
 10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.
 11. Pipe, duct, equipment and controls that are disconnected to perform remodeling work, shall be reconnected in such a manner as to leave systems in proper operating condition.
 12. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner's representative in order to protect systems that shall remain in service.
 13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.
 14. Refer to Architectural "Demolition and/or Alteration" plans for actual location of walls, ceiling, etc., being removed and/or remodeled.

1.16 EQUIPMENT, MATERIALS, BID BASIS

- A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.
- B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.
- C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.
- D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.17 PRECONSTRUCTION CONFERENCE

- A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

1.18 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

- A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.
- B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.
- C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.19 GUARANTEE

- A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.20 SPARE EQUIPMENT

- A. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:
 - 1. Facilities with less than 300 sprinklers – 6 minimum
 - 2. Facilities with 300 to 1000 sprinklers – 12 minimum
 - 3. Facilities with over 1000 sprinklers – 24 minimum

1.21 AS-BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.
- B. The original set of "as-built" drawings shall be scanned and transmitted to the Architect in both full size bond and PDF format.
- C. As Build Drawings: 2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each, PDF Format and AutoCad 2015 files on disk (CD Rom).
 - 1. Number of Copies: Submit one set of marked up record prints.
 - 2. Number of Copies: Submit copies of record Drawings:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one of file prints.
 - 2) Submit record digital data files and one sets of plots.

- 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
- b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and three sets of prints.
 - 2) Submit record digital data files and three sets of record digital data file plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- D. As-Built drawings should indicate the following information as a minimum:
 1. Indicate all addendum changes to documents
 2. Remove Engineer's seal, name, address and logo from drawings.
 3. Mark documents AS-BUILT DRAWINGS.
 4. Clearly indicate: DOCUMENT PRODUCED BY.
 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
 6. Indicate exact location of all underground plumbing and flow line elevations.
 7. Indicate exact location of all underground mechanical piping and elevations.
 8. Indicate exact location of all underground electrical raceways and elevations.
 9. Correct schedule to reflect (actual) equipment furnished and manufacturer.
 10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices, and all deviations and changes from the construction documents in the work shall be recorded.
 11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
 12. Exact location of all electrical equipment in and outside of the building.
 13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
 14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
 15. Cloud all changes.

1.22 START-UP-SERVICE

- A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

1.23 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Prior to final acceptance by the Owner, the Contractor shall provide three (3) copies of an Operations and Maintenance Manual, Bound, indexed, and titled in three-ring, loose-leaf binders. These manuals shall each contain the following:
 1. Clear and concise instructions for operation, maintenance, adjustment, lubrication, wiring diagrams and trouble-shooting data for all mechanical

- equipment. This information shall be prepared by the manufacturer for particular size and model of equipment furnished.
2. Parts list of all parts for equipment, with catalog numbers and other data necessary for ordering of replacement parts.
 3. Provide a competent manufacturer's service engineer for a minimum of two (2) days to instruct the operating personnel including the interpretation of all equipment diagrams. A diary of the training sessions shall be made by the instructing manufacturer's service engineer and witnessed by the Owner's representative and shall be included in the as-built submittal.
 4. Copies of all approved equipment shop drawings, sprinkler layout drawings, hydraulic calculations and as-built plans shall be submitted with the Operation and Maintenance manual.
 5. Index shall include type of equipment, manufacturer, and local representative with address and phone number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. All sprinkler system equipment is to be UL Listed or FM Approved.

2.2 ACCESS PANELS

- A. Group valves together above suspended ceilings, walls, furred spaces to minimize the number of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point.
- B. Furnish access panels of proper size to service concealed valves and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor, but installed by the particular trade for the material within which the access panel is installed.
- C. Panels shall have flush doors with No.16 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated stainless steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.
- D. Access panels are not allowed in gypsum ceilings in public spaces.

2.3 FLOOR, WALL & CEILING PLATES

- A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

2.4 GALVANIC PROTECTION

- A. Insulate joints between dissimilar metals with suitable isolation gasket and bolts with fiber ferrules and washers and/or suitable armored insulation fittings by Clearflow, Crane, Capital, or Epco, so there will be no contact between the metals or with insulating bushings

2.5 INSULATION

- A. The following shall be insulated:
1. All fire suppression water piping above grade (outdoor).
 2. All fire suppression water piping above grade (un-condition space).
 3. Acceptable manufacturers:
 - a. Manville Corporation.
 - b. Certain-Teed.
 - c. Owens Corning Fiberglass.
 - d. Knauf Insulation.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Mineral-Fiber, Glass fibers bonded with a thermosetting resin complying with the following:
1. Preformed Pipe Insulation: Comply with ASTM C 547, Type I, with factory-applied, all-purpose, vapor-retardant jacket.
 2. Blanket Insulation: Comply with ASTM C553, Type II, without facing.
 3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades
 - a. Class I, Grade A for bonding glass cloth and tape to un-faced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to un-faced glass-fiber insulation.
 - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
 - c. Class 2, Grade A, and comply with MIL-A-3316C. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 4. Vapor-Retarder Mastics: Fire and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C 19565C, Type II. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
 6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
 7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- F. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C 552, Type II, Class I.
 2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.
- G. Field-Applied Jackets:
1. General: ASTM C 921, Type I, unless otherwise indicated.
 2. Foil and Paper Jacket: Not acceptable.

3. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
 - a. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. PVC Jacket Color: White.
 - c. PVC Jacket Color: Color-code piping jacket as determined by existing conditions.
 - d. Not to be used for outdoors.
 4. Heavy PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil (0.75 mm) thick, high-impact, ultraviolet-resistant PVC.
 - a. Shapes: 45 and 90-degree, short and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - b. Adhesive: As recommended by insulation material manufacturer. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - c. Not to be used for outdoors.
 5. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.
 - a. Finish and Thickness: Smooth finish, 0.010 (0.25 mm) inch thick.
 - b. Moisture Barrier: 1-mil thick, heat-bonded polyethylene and kraft paper.
 - c. Elbows: preformed 45 and 90-degree, short and long-radius elbows; same material, finish, and thickness as jacket.
 6. Joint Sealants: For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Accessories and Attachments
1. Bands: stainless steel ASTM A666, Type 304, 3/4 inch (20 mm) wide; 0.02 inch (0.050 mm) thick.
- I. Vapor Retardants
1. Mastics: Use materials as recommended by the insulation material manufacturer that are compatible with insulation materials, jackets, and substrates. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II. For indoor applications, use mastics that have a VOC content of <Insert value> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

2.6 HEAT CABLE FOR FREEZE PROTECTION OF PIPING

- A. Provide electric heat tracing on all domestic water piping and sanitary traps exposed to areas subject to freezing.
- B. Provide a complete UL Listed, CSA Certified, or FM Approved system of heating cables, components, and controls to prevent pipes from freezing.
- C. Electric heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc. Cable shall be installed prior to insulation of the piping system.

- D. Electric cable shall be capable of maintaining a minimum water temperature of 40 degrees F at an ambient air temperature of 0 degrees F.
- E. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core, which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.
- F. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 40 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized.
- G. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.
- H. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26 - Electrical Requirements.
- I. Electric heating cable shall be Raychem XL-Trace or approved equal, 5 watts per foot.
- J. All piping shall be insulated with 1" thick fiberglass insulation.
- K. Heating-cable circuit shall be protected by a ground-fault device for equipment protection. This requirement is in accordance with section 427-22 of the NEC-2002.
- L. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires or that use crimps or terminal blocks, shall not be acceptable.

2.7 PIPING SYSTEMS IDENTIFICATION

- A. A marker showing the service and an arrow indicating the direction of flow shall be applied on the following equipment installed under this section of the Specifications:
 - 1. All above ground fire protection standpipe and sprinkler piping
 - 2. All above ground sprinkler drainage piping
- B. A marker showing the service and an arrow indicating the direction of flow shall be applied on all of the following piping systems applicable to the project installed under this section of the Specifications:
 - 1. Sprinkler piping
 - 2. Dry Sprinkler piping
 - 3. Drain piping
 - 4. Pre-Action piping
 - 5. Clean Agent piping
 - 6. FDC piping
- C. Piping identification shall be applied on all piping systems in areas of exposed construction and in areas with accessible or lay-in ceilings. The piping shall be labeled at each wall and floor penetration (both sides), and at connections to equipment. In addition, straight runs of piping shall be labeled at intervals not greater than 25 feet.

- D. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. The vinyl plastic markers shall be as manufactured by Seton Name-Plate Company, W. H. Brady Company, or Westline products.
- E. Each valve in the Plumbing and Fire Protection systems is to be provided with an individually numbered valve tag (stamped numbered tags). Provide Identification Tags on all Emergency fixture and unit or Shut off valves.
- F. Valve tags are to be brass or plastic laminate, 1-1/2" minimum diameter with brass chain and hook for securing to the valve.
- G. Valve tags will include a "P" or "FP" lettering designation to indicate the appropriate system. Numbering shall be consecutive for each service of either the Plumbing or Fire Protection systems. All valves on pumps shall be similar to the valve tags specified above, except they shall be 2-1/2" in diameter, black with white number 2" high for attaching to valve stem by means of brass hook or small solid link brass chain. Tags shall be similar to Seton 2961-25.
- H. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.
- I. One copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

2.8 EQUIPMENT LABELING

- A. All equipment shall be labeled. This shall include all pumps, water heaters, storage tanks, and other similar equipment.
- B. Equipment labeling shall be one of the following, unless noted or specified otherwise.
 - 1. Permanently attached plastic laminate signs with 1" high lettering.
 - 2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.

2.9 PAINTING

- A. All piping exposed to public sight such as standpipe and drain piping in stairwells, or exposed to exterior or moisture conditions such as piping in parking decks, shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect.
- B. All piping exposed to corrosive environment such as pool areas, pool equipment room, sanitization room, and acid room shall be primed and painted with two coats of an enamel-based paint. The color shall be as directed by the Architect
- C. Contractor shall touch-up to match original finish any equipment scratched in shipment or installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.
- B. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.
- C. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.
- D. All equipment and materials shall be installed according to manufacturer's recommendations and shall meet the requirements of NFPA and the Owner's Insurance Underwriter.
- E. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs to allow for exact placement of sprinklers.
- F. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles.
- G. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.
- H. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.
- I. Provide a pressure gauge at the top level of all standpipes.
- J. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.
- K. Horizontal branch piping shall be pitched to mains per NFPA. Locate all sprinkler mains a minimum of 24" above any finished ceiling.
- L. Hydraulic information placards with permanent markings indicating the hydraulic design criteria for each separate system should be installed on each riser.

- M. Provide basket type metal guards over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, storage rooms and all unfinished areas where the head is less than 7 feet-6 inches above finished floor.
- N. All threads for fire department connections shall match the local Fire Department connecting threads and requirements.
- O. Building shall be 100 percent fully sprinklered.
- P. Sprinkle Zones shall comply with NFPA 13, for areas limitations, provide a minimum of TWO sprinkler systems with separate alarm check valve assemblies.
- Q. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.
- R. Stages: At each side of each stage provide a complete Authorities having Jurisdiction and NFPA compliant class III standpipe system with 1.5" and 2.5" fire department hose connections. Mount hose connections in Potter-Romer lockable, clear glass front cabinet. Coordinate exact location of standpipes with stage equipment.
- S. Maintain a minimum 3' horizontal separation between any recessed, pendant sprinkler head and any wall, partition, furr-down, or other vertical surface.
- T. Provide protection in all gymnasium areas.
- U. If a deluge system is required, the system shall be installed so that the deluge system will not engage during a fire drill and/or in fire test mode.

3.3 PREPARATION

- A. Arrangements shall be made to have the openings, inserts, sleeves, blockouts, and such other incidentals set in place ahead of the construction work, where practical, to eliminate the need of cutting and patching. If coring becomes necessary for installation of the work, it shall be done under this section. All holes shall be neatly patched and finished to match the adjoining work in a manner approved by the Architect. All coring shall be performed in a manner not to weaken the structural parts and the manner and method shall be submitted to the Structural Engineer for approval.

3.4 SLEEVES AND ESCUTCHEONS

- A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.
- B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.
- C. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.

- D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.
- E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.
- F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.
- G. Sleeves through interior masonry partitions shall be of 22-gauge galvanized sheet steel.
- H. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.
- I. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer's approval.
- J. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.
- K. Escutcheons shall be provided around all exposed pipe passing through walls, partitions, ceilings and floors in finished spaces. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling.
- L. Supply piping (domestic and /or fire water) shall not pass under footings or through grade beams unless noted otherwise.

3.5 CLEANING

- A. The entire underground and above ground sprinkler system shall be cleaned and flushed in accordance with NFPA 13, 24, 25.
- B. Capped connections shall be located at the ends of sprinkler main piping to facilitate flushing and cleaning of systems.
- C. Remove all trash and debris from site and dispose of legally.

- D. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

3.6 DEMONSTRATION

- A. To obtain complete and final acceptance of the fire protection system, all inspections, approvals, examination and acceptance tests required by the Authority Having Jurisdiction shall be arranged and paid for under this Section.
- B. Sprinkler Contractor shall provide necessary equipment and test materials for testing of the installation.
- C. Testing of the completed sprinkler system for acceptance shall be witnessed by an Owner's representative. Testing should be coordinated with the Authority Having Jurisdiction.
- D. Provide the Owner with as-built drawings and equipment data at completion of construction. As-built drawings shall include an overall graphic drawing of areas covered by each sprinkler zone. This is to include auxiliary drains and inspector test locations. This is to be updated and displayed at riser room. New graphic to include existing systems.
- E. Complete set of as-built drawings (Per NFPA) to be provided to document box at FACP. Drawings to include hydraulic calculation plate information. As-built to be provided in cad and PDF formats to district.
- F. Zone calculation plates to be permeant type (metal or laminate) with printed information attached to each riser.
- G. Provide completed Underground and Aboveground Contractor's material and Test Certificates per NFPA 13 at time of acceptance of test.
- H. Inspections test to be piped into nearest drain to support flow.

3.7 PAINTING

- A. Where exposed in any MEP equipment room, all fire protection piping shall be painted red.
- B. Paint prior to the installation of sprinkler heads; replace any sprinkler heads that come in contact with paint with new heads.

3.8 WORKMANSHIP

- A. All work shall be coordinated with the work to be performed or installed under other sections of these Specifications.
- B. All work shall be executed in a workmanlike manner by workmen skilled in this type of work and shall present a neat appearance when completed.
- C. Offsets shall be provided as required to avoid interference and conflicts with other work, to maximize headroom, or to improve the appearance of pipe runs. All pipe

supports, structural members, hangers and other apparatus necessary to support firmly and substantially the various components of the systems shall be provided under this section.

- D. Nameplates, catalog numbers and rating identifications shall be securely attached to equipment with screws or rivets. Adhesives or cements will not be permitted.
- E. The subcontractor shall be responsible for the protection of the work from injury and shall protect all apparatus with suitable enclosures.

3.9 ERECTION AND INSTALLATION

- A. Installation and workmanship requirements are specified hereinafter.
- B. This subcontractor shall be responsible for the furnishing and installing of all support steel, hangers, rods, clamps, etc., to provide adequate support of all Fire Protection equipment specified herein. All support assemblies shall be UL Listed or FM Approved.

3.10 TESTS

- A. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the “Contractor’s Materials and Test Certificate” shall be submitted to the Architect.
- B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.
- C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.
- D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.
- E. Prior to final acceptance by the Owner, submit the “Contractor’s Material and Test Certificates” indicating system compliance with all applicable sections of NFPA.

3.11 INSTRUCTION OF OWNER’S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.

1. Provide the training during the Owner's regular working day.
2. The Instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.
- B. Time to be allocated for instructions.
 1. Minimum of 8 hours dedicated instructor time.
 2. 4 hours on each of 2 days.
- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 1. One copy to the Owner.
 2. One copy to the Architect/Engineer.
- D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.
- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each "Operation and Maintenance Manual":

3.12 OPERATION AND MAINTENANCE MANUALS

- A. Form of Manuals:
 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 2. Format:
 - a. Size: 8-1/2" x 11".
 - b. Text: Manufacturer's printed data or neatly typewritten
 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 4. Provide fly leaf indexed tabs for each separate product or each piece of operating equipment
 5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable.
 - c. Identity of general subject matter covered in the manual
 6. Binder as specified.
- B. Content of Manual:
 1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.

- a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate.
 - 3) Identify area of responsibility of each
 - 4) Local source of supply for parts and replacement
 - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
2. Product Data:
- a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner).
3. Drawings:
- a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems.
 - 2) Control and flow diagrams.
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
4. Written text, as required to supplement product data for the particular installation:
- a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
5. Copy of each warranty, bond and service contract issued.
- a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure.
 - 2) Instances that might affect validity of warranties or bonds
6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.
 - 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer

- g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear.
 - 2) Items recommended to be stocked as spare parts.
 - h. As installed control diagrams by controls manufacturer.
 - i. Complete equipment internal wiring diagrams.
 - j. Each Contractor's coordination drawings.
 - k. As installed color coded piping diagrams.
 - l. Charts of valve tag number, with location and function of each valve.
 - m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - n. Other data as required under pertinent sections of the specifications.
- 2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 - 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
 - 4. Provide complete information for products specified in Division 23.
 - 5. Provide certificates of compliance as specified in each related section.
 - 6. Provide start up reports as specified in each related section.
 - 7. Provide signed receipts for spare parts and material.
 - 8. Provide training report and certificates.
 - 9. Provide backflow preventer certified test reports.

END OF SECTION 21 05 00

SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.
- C. SECTION 21 05 48 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT.
- D.
- E. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- F. SECTION 21 11 13 – FIRE SUPPRESSION SYSTEMS.
- G. SECTION 21 13 39 - FOAM-WATER SYSTEMS
- H. SECTION 21 22 00 - CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS.
- I. SECTION 21 30 00 - FIRE PUMPS AND EQUIPMENT
- J. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 DESCRIPTION

- A. This section describes the following:
 - 1. Hangers, supports and anchors for the fire protection equipment, tanks and piping systems.
 - 2. Supplementary steel for support or attachment of fire protection tanks, equipment and piping to general construction elements of the project.

1.3 REFERENCES

- A. General:
 - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
 - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
- B. Code of Federal Regulations 29 CFR 1910.7 Definitions and Requirements for a Nationally Recognized Testing Laboratory (NRTL).
- C. National Fire Protection Association (NFPA):
 - 1. NFPA-13 Installation of Sprinkler Systems.
 - 2. NFPA-14 Installation of Standpipe and Hose Systems.

- D. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA):
 - 1. Seismic Restraint Manual: Guidelines for Mechanical Systems - latest edition for the support of ductwork.
- E. UL Fire Resistance Directory, latest edition.

1.4 SUMMARY

- A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.
- B. Section Includes:
 - 1. Pipe, duct, and equipment hangers and supports.
 - 2. Anchors, equipment bases and supports.
 - 3. Sleeves and seals.
 - 4. Flashing, counter flashing and pipe stacks.
 - 5. Firestopping.

1.5 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.6 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- C. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Submit calculations showing compliance with Division 01 Section "Lateral Force Procedures" for seismic bracing of ductwork and piping.

1.7 QUALITY ASSURANCE

- A. Comply with Division 21 Section "Common Results for Fire Suppression."
- B. Supports for Sprinkler Piping: Comply with NFPA 13.
- C. Supports for Standpipes: Comply with NFPA 14.

- D. Do not use black steel devices, components, fasteners, etc. within the Clean Room interstitial space or in any related air flow path. Steel items shall be plated, galvanized, painted, or coated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Unistrut Corp.
 - 2. B-Line Systems.
 - 3. Grinnell.
 - 4. Superstrut,
 - 5. Anvil.
- B. Pipe Supports:
 - 1. Conform to MSS SP58.
 - 2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel ring, UL listed, Grinnell Fig. 69 or equal. Use plastic coated hangers at all uninsulated copper piping.
 - 3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, black or galvanized, adjustable, clevis, UL listed, Grinnell Fig. 260 or equal.
 - 4. Multiple or Trapeze Hangers: 12 gauge (2.67 mm) channel complete with nuts, pipe clamps, pipe straps, and drive-in end caps. Furnish cushion strip on all uninsulated copper piping and; cast iron roll and stand for hot pipe sizes 6 inches and over.
 - 5. Pipe Supported Tight to Wall, Floor, or Ceiling: Superstrut A1200, Unistrut P1000, or equal, 12 gauge channel complete with pipe clamps, nuts, bolts, and end caps. Furnish cushion strip on all uninsulated copper piping and adjustable steel yoke and cast iron roll for hot-pipe sizes 6 inches and over.
 - 6. Vertical Support: Steel riser clamp, UL listed, Grinnell Fig. 261, Superstrut C720, or equal.
 - 7. Floor Support for Pipe Sizes to 4 Inches (101.6 mm) and Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

8. Floor Support for Hot Pipe Sizes 6 Inches (152.4 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support
9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
10. CPVC Tube Support: CTS sized hangers or supports free of sharp edges.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 ATTACHMENT TO STRUCTURE

- A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- B. Connection to Existing Concrete Structure: Concrete anchors conforming to Division 03 Section "Concrete Accessories".
- C. For Suspension from New Formed Concrete Structure: B-Line B3014, Grinnell Figure 282, Superstrut 452, or equal, adjustable concrete insert.
- D. For Support on New Concrete: Galvanized steel headed bolts.
- E. Welded Connection to Steel Beams: B-Line B3083, Grinnell, Superstrut, or equal, steel welded beam attachment.
- F. Clamp Connection to Steel Beams: B-Line, Grinnell, Superstrut, or equal, beam clamp with retaining clip style as required by load.

2.4 SUPORTS, BRACING, AND ACCESSORIES

- A. Miscellaneous Steel: Angles, channels, brackets, rods, clamps, etc., of new materials conforming to ASTM A36. Hot-dip galvanize all steel parts after fabrication where used outdoors or inside the penthouse.
- B. Fasteners: All bolts and nuts, except as otherwise specified, shall conform to ASTM Standard Specifications for Low Carbon Steel Externally and Internally Threaded Standard Fasteners, Designation A307. Bolts shall have heavy hexagon heads, and nuts shall be of the hexagon heavy series. All bolts, washers, nuts, anchor bolts, screws and other hardware used outdoors or inside the penthouse shall be galvanized, and all galvanized nuts shall have a free running fit. Provide bolts of ample size and strength for the purpose intended. All ferrous metal components below grade shall be stainless steel.
- C. Sheet Metal Screws: Plated, size 10 minimum.
- D. Pre-engineered duct and pipe bracing systems may be Mason Industries Seismic Sway Brace System or equal.

2.5 SLEEVES

- A. Sleeves for Pipes through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel.
- B. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Provide stainless steel sheet metal for exterior walls.

- C. Sealant: Acrylic

2.6 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc., or approved equal.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.7 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Unistrut Corp., or approved equal.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.8 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp. Model.
 - 2. 3M fire Protection Products Model.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: Dark gray Black As selected from manufacturer's full range of colors.
- D. Plastic Tube and Pipe: Ensure that the appropriate firestop assembly is used for plastic piping systems. Refer to manufacturer's system selector for more information.

2.9 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.

2. Mineral fiber matting.
 3. Sheet metal.
 4. Plywood or particle board.
 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
1. Furnish UL listed products or products tested by independent testing laboratory.
 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Do not drill or cut structural members.
- E. Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.
- F. Do not attach beam clamp on to bottom of steel joist.

3.2 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 58.
- B. Supports for Gas Piping:
 - 1. Horizontal supports for steel and copper gas piping, threaded or welded, are every six (6) feet for 1/2 inch, every eight (8) feet for 3/4 inch and one (1) inch, and every ten (10) feet for 1-1/4 inches or larger.
 - 2. Vertical supports for steel gas piping, threaded or welded, are every six (6) feet for 1/2 inch, eight (8) feet for 3/4 inch and one (1) inch, and every floor for 1-1/4 inch and larger.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- L. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- M. Support PEX tubing every 32 inches unless a continuous support such as Uponor PEX-a Pipe Support is used. Then:
 - 1. 1/2 - 3/4 inch pipe: 6 feet
 - 2. 1 – 3 inch pipe: 8 feet
- N. Install PEX tubing in accordance with the Uponor Plumbing Design Assistance Manual or the Uponor Professional Plumbing Installation Guide.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.

- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.5 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.
- D. Fire Rated Surface:
 - 1. Seal opening at floor and wall as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- E. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of sealant or caulk suitable for application.
 - 2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

END OF SECTION 21 05 29

SECTION 21 11 13 - FIRE SUPPRESSION SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION.
- C. SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION SYSTEM
- D. SECTION 21 05 48 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- E. SECTION 21 05 48.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- F. SECTION 21 13 39 - FOAM-WATER SYSTEMS
- G. SECTION 21 22 00 - CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS.
- H. SECTION 21 30 00 - FIRE PUMPS AND EQUIPMENT
- I. SECTION 28 31 00 - FIRE DETECTION AND NOTIFICATION SYSTEMS.

1.2 GENERAL REQUIREMENTS

- A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. Contractor shall include within his bid all materials and Work to provide standpipe and 100% sprinkler protection for all areas in new construction or for the entire smoke compartment affected by renovation work.
- D. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Architect shall be notified of the discrepancy.

- E. Interface all new flow and valve supervisory switches with building fire and smoke alarm systems.
- F. *Provide temporary fire protection during the construction phase of Project. Inform and obtain approval from the Owner and General Contractor for any interruptions of existing fire protection, domestic water or fire alarm systems. Adhere to ADM1131 Facilities Planned Utility Outages Policy for outage and shutdown requests.*
- G. All work performed under this specification shall be accomplished in accordance with the requirements and provisions of Section 23 00 00 - Mechanical General.

1.3 WORK INCLUDED

- A. Code compliance, research, design coordination, and installation of a complete and functional hydraulically calculated wet pipe sprinkler system that meets the approval, and is in accordance with the requirements of NFPA Fire Protection Standards listed in 1.4 (a), Underwriters Laboratory (UL), all local and state regulations, and these specifications.
- B. Alarm devices including alarm valves, flow switches/pressure switches, tamper switches and coordination with Fire Alarm and Detection Contractor.
- C. Shop drawings and calculations prepared and submitted in accordance with the requirement of all Authorities Having Jurisdiction.
- D. All permits and approvals of the fire protection system.

1.4 SYSTEMS

- A. Systems to be provided under the Fire Protection design section shall be as listed below. The connection point to the site utility service for the fire protection system shall be at 5'-0" from the exterior of the building unless specifically otherwise noted.
 - 1. Pipes, fittings, and specialties
 - 2. Standpipe systems
 - 3. Automatic Sprinkler Systems
 - 4. Combination Standpipe/Automatic Sprinkler Risers
 - 5. Automatic Dry Sprinkler Systems
 - 6. Pre-action Sprinkler Systems
 - 7. Fire Department Valve Cabinets
 - 8. ESFR Sprinkler Systems

1.5 GUARANTEE

- A. All fire protection work described in the Contract Documents shall be guaranteed for a period of one (1) year from the date of final acceptance. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

1.1 DESIGN STANDARDS

- A. Fire Protection systems shall be designed and installed in accordance with the requirements of the most current version of the following codes, standards and design guides:
 - 1. The International Fire Prevention Code
 - 2. The International Building Code
 - 3. National Fire Protection Association (NFPA) Standards:
 - a. NFPA 101 - Life Safety Code
 - b. NFPA 13 - Installation of Sprinkler Systems
 - c. NFPA 14 - Installation of Standpipe and Hose Systems
 - d. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems
- B. Factory Mutual (FM) Approval Guide
- C. Underwriters Laboratories Inc. (UL)
- D. Owner's Insurance Underwriter Requirements

1.2 SYSTEM DESCRIPTIONS

- A. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- B. Automatic Wet-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- C. Automatic Wet-Type, Class III Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations and NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.
- D. Automatic Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
- E. Automatic Dry-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
- F. Automatic Dry-Type, Class III Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations and NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.
- G. Combination Standpipe/Automatic Sprinkler Risers:
 - 1. Combined standpipe/sprinkler risers or Class I standpipe risers with fire department valves shall be installed in each stairwell within the facility.

- Automatic sprinkler connections will be supplied from combined standpipe/sprinkler risers with a floor control valve assembly at the required locations. Additional standpipes with 2-½" fire department valves are to be provided at required locations throughout the facility per the requirements of NFPA 14.
2. Standpipes will be designed to provide a minimum of 500 gpm. Fire mains supplying standpipes will be hydraulically designed and sized to provide a minimum of 500 gpm at the most remote standpipe and 250 gpm for each additional standpipe to a maximum of 1,000 gpm.
 3. A two-outlet roof manifold complete with fire department valves, caps and chains, automatic ball drip, and isolation valve in a heated space shall be provided at the roof area adjacent to the roof access point.
 4. The fire protection system shall provide 100 psi at the most remote fire department connection; 65 psi may be allowed as a deductive alternate where acceptable to the local authorities and all applicable Owner design criteria.
 5. Standpipes and/or sprinkler connections that are equipped with pressure regulating valves shall be provided with 3" drain risers.
- H. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.
- I. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.
- J. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.
- K. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system in same area as sprinklers actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from sprinklers that have opened.
- L. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.
- M. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system in the same area as sprinklers opens the deluge valve permitting water to flow into the sprinkler piping; a closed solenoid valve in the sprinkler piping is opened by another fire-detection device; then water will discharge from sprinklers that have opened.
- N. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and **[ASCE/SEI 7] <Insert requirement>**.

1.3 DESIGN CRITERIA

- A. Any design documents issued to the contractor are for information only. The Contractor shall be responsible for all code research and obtaining all required flow test data and hydraulically designing a fire protection system that meets all applicable requirements. The Contractor shall arrange for, and conduct a flow test and coordinate its validity with the Authorities Having Jurisdiction.
- B. Upon award of the Contract, a new flow test from the two (2) hydrants nearest the site service entry is to be performed by the Contractor to confirm the flow and pressure characteristics of the existing water service. The completed flow test data along with a utility service map of the area is to be forwarded to the Engineer for confirmation of the existing water service.
- C. Where pre-design of the sprinkler system is required for submission for the building permit: The Fire Protection documents were prepared to be in compliance with all applicable codes and flow test data provided. The Contractor shall review all documents provided and report any modifications required to these documents to the Design Engineer during the shop drawing preparation stage.
- D. All sprinkler heads in occupied areas are to be fast response type heads (155 degrees – 165 degrees Fahrenheit).
- E. All occupied, heated spaces will be protected by wet sprinkler systems.
- F. Inspector test valves will be protected by wet sprinkler systems.
- G. Automatic sprinkler systems shall be designed to the available domestic water pressure available and shall be hydraulically calculated for the following design standards:
 - 1. NFPA 13 Systems

Area/ Usage	Hazard Classification	Density GPM/Sq. Ft.	Remote Area	Maximum Head Spacing	Interior Hose Stream
Public Spaces, Lobbies, Corridors, Offices, Restaurants, Lounges, Meeting Rooms	Light	.10	1,500 sq. ft.	130-200 sq.ft.	100 gpm
Dry Pipe System:	Light	.09	1,950 sq. ft.	130-200 sq.ft.	100 gpm
Mechanical Rooms, Electrical Rooms, Elevator Equipment Rooms, Maintenance/ Storage Rooms, Kitchen/ Food Service Areas and Laundry	Ordinary Group 1	.15	1,500 sq. ft.	130 sq. ft.	250 gpm
Dry Pipe System: Parking Garages, Non- heated Attic Spaces, Ceiling Spaces, Porte Cochere and other spaces containing sprinkler piping that do not have alternate provisions to guarantee a 40° F temperature.	Ordinary Group 1	.14	1,950 sq. ft.	130 sq. ft.	250 gpm
Ballrooms, exterior loading docks, distilleries, barns and stables, dry cleaners, libraries, machine rooms, and auto repair shops.	Ordinary Group 2	.20	1,500 sq. ft.	130 sq. ft.	250 gpm
Dry Pipe System:	Ordinary Group 2	.19	1,950 sq. ft.	130 sq. ft.	250 gpm
Upholstery shops, sawmills, plywood manufacturers, or textile factories, Low-pilled storage, dust or lint generated areas, palletized, bin box, shelf, rack, back to back shelf storage of cartooned group A, storage of tissue and lightweight rolled paper.	Extra Hazard Group 1	.30	2,500 sq. ft.	90-130 sq. ft.	500 gpm
Plastic manufacturing operations, steel manufacturing, and automobile paint spray booths, Space with high combustible or flammable liquids, palletized, bin box, shelf, rack, back to back shelf storage of cartooned group A, storage of tissue and lightweight rolled paper	Extra Hazard Group 2	.40	2,500 sq. ft.	90-130 sq. ft.	500 gpm

- H. Available fire-hydrant flow test records indicate the following conditions:
1. Date: <Insert test date>
 2. Time: : <Insert time> [a.m.] [p.m.]
 3. Performed by: <Insert operator's name> of <Insert firm>
 4. Location of Residual fire Hydrant R: <Insert location>
 5. Location of Flow fire Hydrant R: <Insert location>
 6. Static Pressure at Residual Fire Hydrant R: <Insert psig >
 7. Measured Flow at Flow Fire Hydrant F: <Insert gpm >
 8. Residual Pressure at Residual Fire Hydrant R: <Insert psig >
- I. The fire protection system design shall include a minimum of 10 psi safety factor to allow for future losses in the water service pressure characteristics. The fire protection systems shall not be designed to operate if the residual pressure of the existing water service falls to 20 psi or lower at design flow requirements.
- J. The maximum allowable system velocities shall not exceed 20 fps unless alternate criteria are required by the Owner's Insurance Underwriter.
- K. Coordination:
1. The Fire Protection Contractor shall review the complete set of project documents and coordinate his work with all other trades involved.
 2. Sprinkler head locations shall be coordinated with the architectural reflected ceiling plans. Locations of sidewall heads shall be coordinated with architectural interior elevations.
 3. The fire protection piping and head layout shall function in such a manner so as not to interfere with lighting fixtures, air distribution devices, equipment, piping, and ductwork.
- L. Sprinkler Systems
1. Any design documents issued to the Contractor are for information only. The Contractor shall be responsible for the actual layouts, general routing of piping and additional sprinkler heads to meet all requirements.
- M. All underground mains and appurtenances are to be installed according to NFPA 24.
- N. Combination Standpipe/Automatic Sprinkler Risers
1. Combined standpipe/sprinkler risers or Class I standpipe risers with fire department valves shall be installed in each stairwell within the facility. Automatic sprinkler connections will be supplied from combined standpipe/sprinkler risers with a floor control valve assembly at the required locations. Additional standpipes with 2-1/2" fire department valves are to be provided at required locations throughout the facility per the requirements of NFPA 14.
 2. Standpipes will be designed to provide a minimum of 500 gpm. Fire mains supplying standpipes will be hydraulically designed and sized to provide a minimum of 500 gpm at the most remote standpipe and 250 gpm for each additional standpipe to a maximum of 1,000 gpm.
 3. A two-outlet roof manifold complete with fire department valves, caps and chains, automatic ball drip, and isolation valve in a heated space shall be provided at the roof area adjacent to the roof access point.

4. The fire protection system shall provide 100 psi at the most remote fire department connection; 65 psi may be allowed as a deductive alternate where acceptable to the local authorities and all applicable Owner design criteria.
 5. Standpipes and/or sprinkler connections that are equipped with pressure regulating valves shall be provided with 3" drain risers.
- O. Fire Protection System Alarms
1. The fire protection contractor shall coordinate location and function of all flow, air pressure, supervisory switches, and other dry contacts with the fire alarm contractor.
 2. All control valves in the fire protection system shall be provided with supervisory switches wired for annunciation at the main FACP.
 3. Automatic sprinkler system connections shall be provided with flow switches adjacent to the zone control valve wired for annunciation at the main FACP.
 4. Upright automatic sprinklers will be provided in all elevator shafts and elevator machine rooms. The service to each of these spaces shall be provided with an individual control valve with a supervisory switch and a flow switch located in an adjacent room and wired for annunciation at the main Fire Alarm Control Panel (FACP).

1.4 EQUIPMENT, MATERIALS, BID BASIS

- A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.
- B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products.
- C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction quality and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question.
- D. The Contractor shall coordinate the installation of all fire protection equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.5 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION

- A. The Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored in their original shipping container to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.

- B. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.
- C. The Contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.6 PRECONSTRUCTION CONFERENCE

- A. The Contractor shall schedule a meeting including the sprinkler sub-contractor, Owner, Architect and Engineer prior to the installation of any fire protection pipe hangers.

1.7 SUBMITTALS

- A. It is the responsibility of the Contractor to coordinate the design with the work of all other disciplines so as to avoid conflicts. Where necessary piping shall be offset around ducts, structural members or other obstructions, while maintaining effective coverage, drains shall be provided per NFPA requirements.
- B. Review of the Drawings and hydraulic calculations by PBK is for coordination with the design concept for the project, and for assurance that they have been prepared in a timely manner. PBK is entitled to rely on the technical sufficiency and timely delivery of these documents, as well as on the computations performed by the subcontractor. PBK shall not be required to review or verify those computations or designs for compliance with applicable laws, statutes, ordinances, building codes, and rules and regulations.
- C. Fire Protection shop drawings shall include all data required by NFPA Section 13. Shop drawing plans shall indicate all lights, grilles, soffits, alarms, speakers and other ceiling components, as well as hydraulic node points, to ensure coordination. The Contractor shall submit shop drawings to and secure approval of the Owner's Underwriter, local authority and/or state authorities prior to submission to the Engineer. The Contractor shall not commence work, purchase, or provide any materials to the job site without obtaining shop drawing approval. Shop drawings shall include copies of all hydraulic calculations providing design densities, where applicable. In addition, shop drawings submittals shall include printed catalog specifications and data sheets for all of the following as applicable:
 - 1. Fire department valves
 - 2. Sprinkler heads and accessories
 - 3. Siamese Fire Department connection
 - 4. Fire valve cabinets
 - 5. Test header
 - 6. Roof manifold
 - 7. Backflow preventer
 - 8. Cutting oil indicating compatibility with the CPVC sprinkler piping
- D. A letter signed by an officer of the Contractor's company shall be included in the submittal book that states the following items meet or exceed the requirements of the specifications:
 - 1. Pipe and fittings
 - 2. Valves
 - 3. Pipe supports
 - 4. Pipe accessories

5. Pipe labels and valve tags
 6. Flow switches
 7. Tamper switches
- E. All required submittal data other than fire protection shop drawings shall be transmitted simultaneously in hard ring binders with the associated specification section and the item submitted clearly identified. Partial submittals will be returned without review unless previously agreed to by the Engineer.
- F. The Contractor shall not proceed with any work without final approved submittal data bearing all approval stamps.
- G. Shop drawings and hydraulic calculations are to be sealed by a NICET III or IV sprinkler designer licensed in the state of Texas (**Edit other State as needed**).
- H. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.8 SPARE EQUIPMENT

- A. The Contractor shall furnish and install a cabinet located in the fire service entry room with the quantity of each type of sprinklers and wrenches as required by NFPA 13:
1. Facilities with less than 300 sprinklers – 6 minimum
 2. Facilities with 300 to 1000 sprinklers – 12 minimum
 3. Facilities with over 1000 sprinklers – 24 minimum

PART 2 - PRODUCTS

2.1 GENERAL

- A. All sprinkler system equipment is to be UL Listed or FM Approved.
- B. Manufacturers.
1. Pipe.
 - a. Wheatland Tube
 - b. Youngstown Tube Company
 - c. Bull Moose Tube
 - d. Paragon
 2. Sprinkler and Alarm Valve.
 - a. Viking Corp
 - b. Globe Fire Sprinkler Corp
 - c. Tyco
 - d. Reliable
 - e. Victaulic Company
 3. Valve
 - a. Milwaukee
 - b. NIBCO
 - c. Bray
 - d. Mueller Co
 - e. Tyco Fire
 - f. Victaulic Company
 - g. Crane

4. Specialty Valve
 - a. Potter-Roemer
 - b. Croker
 - c. Guardian Fire Equipment
 - d. Elkhart Brass Mfg
 - e. Tyco Fire
- C. All piping, materials and equipment used in the installation of sprinkler and standpipe systems shall be new and listed as approved by the Underwriters' Laboratories, Inc., List of Inspected Fire Protection Equipment and Materials and the Factory Mutual Testing Laboratories List of Approved Equipment, Fire Protection Devices and Devices Involving Fire Hazard and shall be the latest design of the manufacturer.
- D. Pressure ratings of pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the designed system pressures in which they are installed.
- E. The installing Contractor shall identify piping, fire department connections, valves and hydraulic design information in accordance with applicable NFPA Standards.

2.2 MATERIALS

- A. All piping shall be made in the USA and be labeled according to City and /or State manufacturers. Pipe shall be protected with MIC shield coating.
- B. All materials, pipe, valves and equipment furnished under this section shall be new and approved by NFPA, Underwriters Laboratories Inc. (UL), Factory Mutual (FM) and American Water Works Association (AWWA) where applicable.
- C. Pipe and Fittings:
 1. Piping – Schedule 40 ASTM A-53, A-795, A-135, black steel piping for branches (1 inch – 2 inches) and schedule 10 ASTM A-53, A-795, A-135 (2-1/2 inches – 8 inches) black steel for mains.
 - a. Piping (piping only, excluding fittings) for dry systems shall be Schedule 40 ASTM 53 galvanized steel in all pipe sizes, screwed galvanized cast or malleable iron fittings through 2", grooved couplings for 2-1/2" and larger pipe sizes.
 - b. Buried Water Service Entrance Piping.
 - 1) Pipe - Cement mortar lined ductile iron.
 - 2) Fittings – Cement mortar lined ductile iron using mechanical joints.
 - 3) Optionally, where building structural components permit, water service entrance may be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum Working pressure of 175 psi with grooved-end connection on the outlet (building) side and a cast iron pipe size coupler on the underground (inlet) side.
 - 4) All pipe and fittings shall be encased with polyethylene film having a minimum thickness of 8 mils.
 2. Fittings under 2-1/2 inches screwed cast iron, 175-pound S.W.P., 2-1/2 inches and larger, flanged, or grooved pipe and fittings to accept a bolted type clamp with gasket.
 3. Grooved Couplings & Fittings: ductile iron with gasket and two bolts, 300 psi working pressure. Victaulic, Firelock fittings.

4. Flanges – cast iron, 175 pound S.W.P., with threaded inlet, or Victaulic Mod. #741.
 5. Hangers to meet NFPA 13 spacing and type.
- D. Control Valves: All control valves are to be electrically supervised. A pressure gauge, water flow switch and test connection with drain shall be provided downstream. The installation shall be per NFPA 13 requirements.
1. 2-1/2 inches and under – 175 psi, Milwaukee “Butterball” with built-in tamper switches.
 2. Over 2-1/2 inches – UL listed and FM approved, 175 psi, butterfly valves or OS&Y with tamper switch.
 3. All butterfly valves shall have a built in tamper resistant switch for supervision of the open position. The switch shall be contained within a NEMA Type 1, general purpose indoor rated housing. Either unauthorized removal of the switch housing (when the valve is open) or closing the valve, shall cause the switch contacts to change position. The switch shall have four conductors to accommodate connections to Style 4 or Style 6 signaling line circuit devices.
- E. Check Valves:
1. Check valves 2-1/2 inches and larger shall be iron body swing check with cast brass hinge, rod, and brass faced discs.
 2. Check valves 2 inches and smaller shall be UL listed brass body and all brass fitted.
- F. Alarm Check Valves: Shall be for vertical installation, cast iron, complete with retard chamberport to alarm, pressure gauges, main drain, electric alarm pressure switch with dual contacts suitable for either open or closed circuit.
1. Control valve, check valve, and pressure or flow switch tied to fire alarm system and sprinkler alarm bell.
 - a. 2-1/2" to 3, Class 150, iron body, bronze disc, flanged or groove ends, TYCO Fire Products LP; AV-1-300, UL Listed for fire service.
 - b. 4" and larger, Class 150, iron body, bronze trim, flanged ends, TYCO Fire Products LP; AV-1-300, flanged, UL Listed for fire service.
- G. Dry Check Valves: Subject to compliance with requirements, provide TYCO Fire Products LP; DPV-1.
1. Standard: UL 260
 2. Design: Differential-pressure type
 3. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 4. Air Compressor:
 - a. Manufacturers: Subject to compliance with requirements, **[provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
 - b. Basis-of-Design Product: Subject to compliance with requirements, provide **[product indicated on Drawings] <Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
 - 1) Gast Manufacturing Inc.
 - 2) General Air Products, Inc,
 - 3) Viking Corporation.

- c. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - d. Motor Horsepower: Fractional.
 - e. Power: 120-V ac, 60 Hz, single phase.
- H. Preaction System:
- 1. [Double interlock] [single interlock] [non-interlock] pre-action valve and trim to NFPA 13 and UL listed for fire services.
 - 2. Valve and trim assembly to complete with all required valves, alarm line pressure switches, air supervisory switches, valve position supervisory switches, alarms, pressure gauges and alarm test connections.
 - 3. [Air supply system capable of charging the piping system to required pressure within 30 minutes, complete with air compressor, air tank, ball valve and pressure switch] [Connect to building utility air system] to maintain sprinkler system piping pressurization.
 - 4. [Preaction valve and all components preassembled within a lockable steel metal enclosure, red color, pre-wired electrical connections, system control panel and pressure readings visible from front of cabinet, accessible side and back panels].
- I. Switches:
- 1. Water Flow Switches: Shall be paddle type water flow alarm (or pressure switch of retard chamber) and with double contacts for either open or closed circuit operation for connection to building fire alarm system.
 - 2. Tamper Switches: Shall be designed as an integral part of control valve assembly or tamper switch shall have double acting, spring loaded plunger to activate a single-pole double-throw switch for valve supervision of OS&Y type control valves.
- J. Fire Department Connections (as indicated on plans):
- 1. Fire department connection shall be 2-way exposed Siamese type, 2-1/2" x 2-1/2" x 4" size, cast brass body, polished chrome finish for all exposed surfaces, cast brass escutcheon, and brass female hose inlets having individual clapper valves, plugs, and chains. Assembly shall be located with the center line of the hose inlets at 2'-6" above adjacent grade. Inlet threading shall be National Standard or same as municipal fire department, as required. Assembly shall be UL Listed, FM Approved. Wall Mounted: Potter Roemer 5710 series or approved equal.
 - 2. Free Standing: Potter Roemer 5760 series or approved equal.
- K. Sprinkler Head Escutcheons.
- 1. Finish for all escutcheons shall match the finish of sprinkler heads on which they are used. Use white cover plates for white painted soffits and white acoustical ceiling tile, black cover plates for black lay-in acoustical ceiling tile, custom color to match specialty ceilings.
- L. Water Motor Gong
- 1. Provide a water motor gong. No Electric Bell.
- M. Fire Valve Cabinet
- 1. 1810 Series cabinets accommodate a single 2-1/2" (6.4 cm) fire dept valve with cap and chain; 1810-10 Series cabinets accommodate a single 2-1/2" (6.4 cm) fire dept valve, 2-1/2" x 1-1/2" Reducer and 1-1/2" Cap.

2. Cabinet shall be 20-gauge steel with polyester coating, recessed with flush full metal hinged door with cam catch and integral shelf for fire extinguisher. Cabinet shall be Potter-Roemer 1810 series or approved equal.

N. Roof Manifold

1. Wall mount manifold to be three outlet horizontal configuration, cast brass body with threaded 2-1/2" male outlets complete with valves, chains and caps, rough brass finish. Provide accessible indicating type shut off valve with supervisory switch (normally closed) and automatic ball drip to roof. Roof manifold to be Potter-Roemer 5880 series or approved equal.

2.3 STAND PIPES

- A. Provide a complete stand pipe system with 2 1/2" fire hose connections in compliance with Authority Having Jurisdiction Fire Marshal's requirements for the entire building with separate stand-pipes at auditorium stage and entrance to the auditorium.

1. Building system shall provide a 2 1/2" fire hose connection at each landing of each egress stairwell and additional connections throughout the facility in order to provide complete fire hose coverage based on a 150 foot of hose with 50 foot of water spray. Locate fire hose connections in Fire Marshal and Architect approved locations such as stairwells and mechanical rooms and provide required signage. Contractor shall include stand pipe water flow requirements in hydraulic calculation for sizing of all fire water main piping and fire pump. Contractor shall include in submittal a plan showing location of all fire hose connections for approval by Authority Having Jurisdiction Fire Marshal prior to fabrication and rough-in. System shall also comply with NFPA 13 for hose connections for fire department use.
2. Provide a complete stand pipe system on each side of the auditorium stage.
3. Provide a complete stand pipe system on each side of the entrance to the auditorium.

2.4 AUTOMATIC SPRINKLER SYSTEM MATERIALS

- A. The underground fire protection service shall be provided with thrust blocks and rods and clamps at the service entry.

- B. Automatic sprinklers shall be provided as follows:

1. Public Spaces with Gypsum and Lay-in Ceilings
 - a. Fully concealed type sprinklers, glass element, or fusible link style, quick response sprinklers shall be provided in all areas with gypsum ceilings unless otherwise noted. Temperature rating of sprinklers shall be 155 – 165 degrees. Ceiling coverplate shall be factory painted to match the adjacent ceiling color; submit painted sample to the Architect for approval. Sprinkler to be Tyco, Reliable, Victaulic or Viking Horizon Mirage concealed sprinkler or approved equal.
 - b. Small frame glass element, semi-recessed, quick response pendent sprinklers shall be provided in all areas with lay-in ceilings unless otherwise noted. Temperature rating of sprinklers shall be 155 – 165 degrees. Sprinkler and escutcheon to be white finish. Sprinkler to be Tyco, Reliable or Viking Microfast Model M series with Model E-1 escutcheon.
2. Back-of-House Spaces and Unfinished Spaces with no Ceiling
 - a. Quick response upright pendent sprinklers shall be provided in all areas with no ceiling. Temperature rating is to be 165 degrees unless

- conditions require higher temperature. Finish of sprinkler to be rough brass. Sprinkler to be Tyco, Reliable or Viking Microfast Model M.
3. Kitchen Coolers and Freezers
 - a. Standard response semi-recessed chrome plated dry pendent sprinklers with sprinkler guards will be provided in all coolers and freezers. Barrel length shall be a minimum of 12" from the base of the tee to the top of the freezer. Sprinkler and escutcheon shall be polished chrome finish. Sprinkler shall be Tyco, Reliable or Viking Model M.
 4. Pool areas
 - a. All sprinkler heads in pool areas, pool equipment room, sanitized room and acid room shall be US Listed/FM Approved quick-response Stainless Steel heads (155 degrees Fahrenheit). Heads must be wax coated. Viking VK338 and VK339 or equal
 5. Exterior Overhangs and Elevator Shafts
 - a. Standard response chrome plated dry horizontal sidewall or upright sprinklers are to be provided. Barrel length shall be a minimum of 12". Sprinkler and escutcheon shall have UL Listed polyester or Teflon corrosion protection at exterior overhangs and rough brass finish at elevator shafts. Sprinkler shall be Viking Model M.
- C. All outdoor sprinkler heads shall be wax coated.
- D. Alternate acceptable manufacturers with equivalent sprinklers are Automatic, Central, Anvil International, Gem and Reliable.
- E. Sprinkler guards shall be installed on all sprinklers 7'-0" or less above floor.
- F. Provide sprinklers at the highest and lowest level of all stairwells.
- G. Provide sidewall sprinklers at the top end and bottom of all elevator hoistways. Sprinklers may be omitted from traction elevators on non-combustible elevator shafts and cabs which meet the requirements of ASME A.17.1 and where acceptable to the local authorities.
- H. Provide sprinklers in electrical rooms and elevator machine rooms unless specifically prohibited by local authorities; the sprinkler supply to each space shall be provided with a supervised valve and flow switch. Coordinate the intermediate temperature rating of the sprinkler head in all elevator machine rooms with the electrical contractor to ensure sprinkler operation will not occur prior to activation of the heat detector and the shunt trip circuit breaker.
- I. Sidewall sprinklers shall be installed in all electrical rooms, electrical closets and elevator machine rooms where adequate coverage is provided. Upright sprinklers shall be installed in these spaces when coverage limitations of the sidewall sprinklers are exceeded. Piping shall not be installed above any electrical equipment, switchboard or panelboard. Piping shall offset around surface mounted light fixtures where possible, provide a minimum of 6" clearance below the bottom of the light fixtures at all locations.
- J. The property is to be fully sprinklered throughout per the requirements of NFPA unless specifically noted otherwise. Elimination of sprinklers in electrical rooms, elevator shafts and elevator machine rooms shall be clearly indicated on the shop drawing submittal noting the exception applied for the deletion of sprinklers in these spaces.

- K. The Contractor shall provide and place suitable signs indicating the purpose of each control valve, test connection, main and auxiliary drain, etc., as required.
- L. Provide higher intermediate temperature rated sprinklers in all areas required due to service conditions and as required by NFPA 13.
- M. Provide sprinkler connections to all required food service hood suppression systems.
- N. Sprinkler guards shall be installed on all sprinklers located in cafeteria and the gym.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas for conditions under which work is to be performed. Report in writing to the Architect all conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. The Drawings are diagrammatic and the final arrangement of the work shall suit field conditions, the characteristics of the materials used and coordination with all other disciplines and the building components and finishes. Verify all dimensions in the field. Access and clearances must be provided and maintained for the proper operation, maintenance service and repair of the work.
- B. No sprinklers are to be installed prior to the building being completely sealed in from external moisture and conditions.
- C. All standpipe, sprinkler and drain piping exposed to sight in stairwells is to be painted with two coats of an epoxy based paint, color to be selected by the Architect.
- D. All equipment and materials shall be installed according to manufacturer's recommendations and shall meet the requirements of NFPA and the Owner's Insurance Underwriter.
- E. All sprinklers in spaces visible to public view shall be located symmetrically in relation to ceiling design elements, lighting fixtures, speakers, diffusers, etc. All ceiling components are to be indicated on the submittal drawings as noted previously to ensure coordination with all ceiling elements and devices. Piping to sprinklers in these areas is to be provided with arm-overs to allow for exact placement of sprinklers.
- F. Sprinklers shall be installed at the centerpoint of all 2' x 2' lay-in ceiling tiles, and at the centerpoint or 1' from the ends of 4' x 2' ceiling tiles. For every sprinkler head, tap main/branch pipe serving each individual sprinkler head shall come from the top of pipe to prevent trash from collecting at head. **(Piping laterals to a sprinkler head is FORBIDDEN off the bottom of the main or lateral piping system).**
- G. Where pipe is installed above suspended ceilings, it shall be located in the clear space above the suspended ceiling and the pendent sprinklers shall be located to clear the ceiling supporting grid system, the ceiling mounted fixtures, and air conditioning ducts and outlets.

- H. The Contractor shall install additional pendent sprinkler heads under all ductwork or other obstructions which are over 48" wide in accordance with NFPA-13 in areas of exposed construction.
- I. Dry pipe systems shall be specified as installed with the longitudinal weld seam located above the horizontal centerline of the pipe, and with drain valves installed at all low points regardless of trapped water volume. Require that mains and branch lines be pitched at least 1/2 in. per 10 ft in all locations, including in non-refrigerated areas (areas not subject to freezing).
- J. Provide a pressure gauge at the top level of all standpipes.
- K. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.
- L. Horizontal branch piping shall be pitched to mains per NFPA. Locate all sprinkler mains a minimum of 24" above any finished ceiling.
- M. Hydraulic information placards with permanent markings indicating the hydraulic design criteria for each separate system should be installed on each riser.
- N. Provide basket type metal guards over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, gymnasium areas, storage rooms and all unfinished areas where the head is less than 7 feet-0 inches above finished floor.
- O. All threads for fire department connections shall match the local Fire Department connecting threads and requirements.
- P. Building shall be 100 percent fully sprinklered.
- Q. Sprinkle Zones shall comply with NFPA 13, for areas limitations, provide a minimum of TWO sprinkler systems with separate alarm check valve assemblies.
- R. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.
- S. Stages: At each side of each stage provide a complete Authorities having Jurisdiction and NFPA compliant class III standpipe system with 1.5" and 2.5" fire department hose connections. Mount hose connections in Potter-Romer lockable, clear glass front cabinet. Coordinate exact location of standpipes with stage equipment.
- T. Maintain a minimum 3' horizontal separation between any recessed, pendant sprinkler head and any wall, partition, furr-down, or other vertical surface.
- U. If a deluge system is required, the system shall be installed so that the deluge system will not engage during a fire drill and/or in fire test mode.

3.3 CLEANING

- A. The entire underground and above ground sprinkler system shall be cleaned and flushed in accordance with NFPA 13, 24, 25.

- B. Capped connections shall be located at the ends of sprinkler main piping to facilitate flushing and cleaning of systems.
- C. Remove all trash and debris from site and dispose of legally.
- D. All equipment shall be thoroughly cleaned and left in a satisfactory condition for proper operation at project completion. All equipment shall be partially or fully re-painted as required to provide an appearance of new equipment.

3.4 TESTS

- A. Tests of all fire protection systems and equipment, underground and inside piping including alarm and detection devices shall be scheduled with one (1) week prior notification to a local representative of the Underwriter and the Architect. All tests and test procedures shall be in accordance with the applicable NFPA standards. After completion of all tests, the “Contractor’s Materials and Test Certificate” shall be submitted to the Architect.
- B. The Contractor shall supply all materials, labor, utilities and power required for testing. Preliminary tests shall be performed to prove work is satisfactory prior to requesting a test inspection. Sectional tests shall be made before insulation or concealing any piping.
- C. Repair all defects disclosed by tests or, if required by the Architect, replace defective work with new systems and materials at no additional cost to the Owner. Repairs to piping systems shall be made with new material. No caulking of screwed joints, cracks or holes will be accepted. Make tests in stages to facilitate work of others.
- D. The Contractor shall be responsible for the repair and/or replacement cost installed and finishes damaged by leaks, tests and/or repair and replacement of his work at no additional expense to the Owner.
- E. Prior to final acceptance by the Owner, submit the “Contractor’s Material and Test Certificates” indicating system compliance with all applicable sections of NFPA.

END OF SECTION 21 11 13

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested and performing their intended function.
- B. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- C. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition for all systems. All work shall be accomplished by workmen skilled in the various trades involved.
- D. Phased Construction:
 - 1. This project consists of work that must be accomplished in a specific sequence on premium time to avoid interruption of services to existing portions of the buildings and mechanical, plumbing and fire protection systems that must remain operational
 - 2. Contractor shall include any and all temporary services required to keep the Owner occupied portions of the buildings operation without interruption of HVAC, plumbing and fire protection services for the duration of the project.
 - 3. Refer to Architectural drawings for description of phasing, stage all mechanical, plumbing and fire protection work accordingly.
- E. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

1.3 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- B. All materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture and comply with the Buy America Act, unless approved otherwise by engineer or owner.

- D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner.
- E. An approved contractor for the work under this division shall be:
 - 1. A licensed specialist in this field and have the personnel, experience, training, skill, and organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.

1.4 WORK INCLUDED

- A. SYSTEMS: Plumbing Systems installed and work performed under this Division of the Specifications shall include, but not necessarily be limited to, the following as noted below. The connection point for all systems from the site utilities shall be as 5'-0" from the exterior of the building unless specifically otherwise noted.
 - 1. Domestic cold, hot and hot water recirculation systems
 - 2. Sanitary, drainage, waste and vent systems
 - 3. Natural gas/propane gas system
 - 4. Primary and emergency storm drainage systems
 - 5. Propane/air mixture gas systems
 - 6. Grease waste and waste systems from food service areas
 - 7. Domestic water softening system
 - 8. Compressed air system
 - 9. Fuel Oil system
- B. Contract quality control including workmanship, manufacturer's instructions, mock-ups and demonstrations.
 - 1. MOCK-UPS
 - a. Assemble and erect the specified equipment and products complete, with specified anchorage and support devices, seals and finishes.
 - b. Do not proceed with any work involving a mock-up, until the related mock-up has been approved in writing.
 - c. Acceptable mock-ups in place shall be retained in the completed work.
 - d. Perform tests and submit results as specified.
 - 2. SCHEDULING MOCK-UPS
 - a. Schedule demonstration and observation of mock-ups, in phases, with Architect/Engineer.
 - 1) Rough-in.
 - 2) Finish with all appurtenances in place.
 - 3) Insulation installed.
 - 4) Demonstrations

1.5 COMPLETE PERFORMANCE OF WORK

- A. All labor, materials, apparatus, and appliances essential to the complete and proper functioning of the systems described and/or indicated herein, or which may be reasonably implied as essential, whether mentioned in the Contract Drawings and

specifications or not, shall be provided by the Contractor. The entire installation shall be ready in every respect for the satisfactory and efficient operation when completed.

- B. Provide all rigging required for complete installation and furnish drawings showing necessary points of support, reactions and supplementary bracing. This shall be submitted for approval by the Owner. Should any shoring be required, provide same after Owner's approval.
- C. Become thoroughly acquainted with the work involved, obtain and verify at the building all measurements necessary for the proper installation of work. Furnish to other Contractors any information relating to work of this division necessary for the proper installation of their contracts. Confer with other Contractors for finish adjacent to work of this section and arrange to have visible portions of the work (such as access doors, grilles, escutcheons, etc.) fit in and harmonize with the finish in a manner satisfactory to the Architects.
- D. Transmit to trades doing work of other sections all information required for work to be provided under their respective sections (such as fresh water connections, foundations, electric wiring, access doors, and the like) in ample time for installation.
- E. Where disagreements occur between the plans and the specifications, or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the Base Bid.

1.6 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.

- F. The mechanical trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment specified and scheduled on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.7 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.
- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.
- D. The locations, arrangement and extent of equipment, devices, and other appurtenances related to the installation of work shown on the Drawings are approximate. The Contractor shall not scale drawings, but shall refer to the architectural drawings for exact dimensions of building components. Should a conflict exist between the architectural and engineering drawings regarding dimensions and scale, the Contractor shall notify the

Architect of the discrepancy for resolution.

- E. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.

1.8 SUBSTITUTIONS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. See division 01 specification for additional requirements.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect at least **seven (7)** days prior to the date for receipt of proposals. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. The Architect and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- D. **No substitutions will be considered after the Award of Contract.**
- E. Requests for Substitutions: Submit three (3) copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related Specifications Section and Drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include, as appropriate, with each request, the following information:
1. Product data, drawings and descriptions of products, fabrication and installation procedures.
 2. Samples, where applicable or requested.
 3. A detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect, where applicable.
 4. Coordination information, including a list of changes or modifications needed by other parts of the work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.
 5. A statement indicating the effect the substitution will have on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
 6. Cost information, including a proposal of the net change, if any in the Contract Sum.
 7. Certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to

perform adequately.

8. A statement indicating the Contractor will reimburse the Owner and pay for all costs, including Architect/Engineer's re-design and evaluation costs resulting from the use of the proposed substitution.
9. Condition: The Contractor's request for substitution will be received and considered when extensive revisions to Contract Documents are not required, when the proposed changes are in keeping with the general intent of the Contract Documents, when the request is timely, fully documented and properly submitted, and when one (1) or more of the above conditions are satisfied, all as judged and determined by the Architect/Engineer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

1.9 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8 inch scale or larger, one drawing per building area. Provide 1/4 inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
 1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnished product named in Specification and or Drawings.
 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.
- F. All approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to equipment being submitted to the Engineer.
- G. Review of submittals by the Engineer does not relieve the Contractor from the responsibility for complying with all requirements of the Contract Documents.

Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements of all approved equipment with other trades and disciplines such as roof openings, wall openings, electrical characteristics, etc.

- H. All submittals shall be identified by the equipment mark or tag identification numbers shown on the Contract Drawings. Each individual submittal item shall be marked to show which specification section pertains to the item.
- I. Submittals shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any proposed deviations from specified equipment shall be clearly indicated on the submittal.

1.10 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.11 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.12 EXISTING CONDITIONS

- A. The Contractor shall be familiar with the required scope of work to accomplish the work required by these documents. All demolition work implied or required shall be included in the scope of this contract.
- B. Outages of services are required by the new installation will only be permitted at a time approved by the Owner. The contractor shall allow the Owner a 2 week window in order to schedule required outages. The time allowed for outages will not be during normal operating hours unless otherwise approved by the Owner. All costs for outages, including overtime charges, shall be included in the contract amount.
- C. Work Sequence, Timing, Coordination with Owner:
 - 1. During the construction of this project, normal facility activities will continue in existing buildings until new buildings or renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.
- D. Demolition and Work within Existing Buildings:
 - 1. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to the existing piping, duct, equipment and other apparatus related to this phase of the work. However, the Contractor shall be responsible for verifying all existing conditions. The Contractor shall visit the existing site to inspect the facilities and related areas. The Contractor shall inspect and verify all details and requirements of all the Contract Documents,

- prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by his contractor, who shall produce drawings which shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be part of this Contract.
2. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.
 3. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including associated system connections. Where duct or pipe is to be capped for future extension or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric connection, the Electrical Contractor shall disconnect equipment and remove wiring back to panel or disconnect switch. Contractor shall remove or relocate equipment and associated disconnect.
 4. During the construction and remodeling, portions of the Project shall remain in service. Construction equipment, material tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades separating work area from occupied areas.
 5. Certain work during the demolition and construction phases of construction may require temporary evacuation of the occupants. Coordinate and schedule all proposed evacuation with the Project Administrator at least seventy-two (72) hours in advance in writing.
 6. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.
 7. Equipment, piping or other potential hazards to the occupants of the building shall not be left overnight outside of the designated working or construction area.
 8. Make every effort to minimize damage to the existing building and the owner's property. Repair, patch or replace as required any damage which might occur as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.
 9. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment and plumbing fixtures as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, ventilation and plumbing services for the existing areas.
 10. All existing plumbing fixtures, pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.
 11. Pipe, duct, equipment and controls that are disconnected to perform remodeling work, shall be reconnected in such a manner as to leave systems in proper operating condition.

12. No portion of the fire protection systems shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner's representative in order to protect systems that shall remain in service.
13. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.
14. Refer to Architectural "Demolition and/or Alteration" plans for actual location of walls, ceiling, etc., being removed and/or remodeled.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.14 GENERAL ELECTRICAL REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.
- B. Electrical materials and work provided shall be in accordance with Division 26.
- C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.15 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

- A. Mechanical equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL, and shall meet the latest edition of the National Electrical Code.
- B. Unless otherwise specified, the electrical supply being furnished is a 480 volt, 3 phase, 3 wire, 60 hertz source. A neutral connection will not be provided, the manufacturer shall include any transformers for equipment requiring other voltages (277volt, 220 volt, 120 volt, 24 volt, etc.).
- C. Electric Motors:
 1. For each piece of equipment requiring electric drive, provide a motor having starting and running characteristics consistent with torque and speed requirements of the driven machine.
 2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of driven equipment on shop drawings.
 3. Each motor shall be furnished in accordance with Section 23 05 13 - Common Motor Requirements For HVAC Equipment.
 4. Contractor shall verify electrical characteristics of each motor with electrical drawings.

5. Motors which are shipped loose from equipment shall be set by supplying subcontractor.
6. Alignment of motors factory coupled to equipment and motors field coupled to equipment shall be rechecked by millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and again after 48 hours of operation in designed service.
7. Where possible, motors shall be factory mounted.

1.16 AS BUILT DRAWINGS

- A. The Contractor shall maintain a record set of drawings indicating all changes in the work from that shown in the Contract Documents. Prior to final acceptance by the Owner, the Contractor shall assemble the complete set of as-built drawings that accurately reflects all changes to indicate actual final construction. All concealed piping shall be dimensionally located from at least two (2) column lines or major building structure elements. Drawings shall be a minimum of 1/8" scale.
- B. The original set of "as-built" drawings shall be scanned and transmitted to the Architect in both full size bond and PDF format.
- C. As Build Drawings: 2 sets are for the Owner's use and one set is for the Architect/Engineer's records). Delivery of these as-built prints and reproducible is a condition of final acceptance. Provide record drawings on one set each, PDF Format and AutoCad 2015 files on disk (CD Rom).
 1. Number of Copies: Submit one set of marked up record prints.
 2. Number of Copies: Submit copies of record Drawings:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one of file prints.
 - 2) Submit record digital data files and one sets of plots.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and three sets of prints.
 - 2) Submit record digital data files and three sets of record digital data file plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- D. As-Built drawings should indicate the following information as a minimum:
 1. Indicate all addendum changes to documents.
 2. Remove Engineer's seal, name, address and logo from drawings.
 3. Mark documents AS-BUILT DRAWINGS.
 4. Clearly indicate: DOCUMENT PRODUCED BY.
 5. Indicate all changes to construction during construction. Indicate actual routing of all piping, ductwork, etc. that were deviated from construction drawings.
 6. Indicate exact location of all underground plumbing and flow line elevations.
 7. Indicate exact location of all underground mechanical piping and elevations.
 8. Indicate exact location of all underground electrical raceways and elevations.
 9. Correct schedule to reflect (actual) equipment furnished and manufacturer.
 10. During the execution of work, maintain a complete set of drawings and specifications upon which all locations of equipment, ductwork, piping, devices,

and all deviations and changes from the construction documents in the work shall be recorded.

11. Location and size of all ductwork and mechanical piping above ceiling including exact location of isolation of domestic and mechanical valves.
12. Exact location of all electrical equipment in and outside of the building.
13. Fire Protection System documents revised to indicate exact location of all sprinkler heads and zone valves.
14. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
15. Cloud all changes.

1.17 START-UP-SERVICE

- A. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of all major equipment and systems including booster pumps, water heaters, sewage ejectors, lift stations, fuel oil systems, etc. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

1.18 COORDINATION OF TRADES

- A. The Contractor shall give full cooperation to other trades, and shall furnish all information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.
- B. Piping and other plumbing equipment shall not be installed without first coordinating the installation of same with other trades. The Contractor, at his own expense, shall relocate all uncoordinated piping and other plumbing equipment installed should they interfere with the proper installation and mounting of electrical, HVAC equipment, ceilings and other architectural or structural finishes.
- C. The Contractor shall coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation.
- D. In areas where more than one trade is required to use common openings in beams, joists, chases, shafts and sleeves for the passage of conduits, raceways, piping, ductwork and other materials, the Contractor must coordinate the positions of all piping and equipment to be furnished under this section so that all items including the materials and equipment of other trades may be accommodated within the space available.
- E. The Contractor shall confirm that work installed under this section does not interfere with the clearances required for finished columns, pilasters, partitions, walls or other architectural or structural elements as shown on the Contract Documents.
- F. Work that is installed under this Contract which interferes with the architectural design or building structure, shall be removed and relocated as required at no additional cost to the Contract.
- G. All offsets, fittings, valves, devices and accessories which may be required are to be provided under this Contract. The Contractor shall examine the entire set of Contract Documents and carefully investigate the structural and finish conditions affecting all his work and shall arrange such work accordingly for the complete satisfactory operation of

all systems, providing such fittings, traps, valves, devices and accessories as may be required to meet such conditions.

1.19 WARRANTY

- A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.
- B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of one (1) year from date of building acceptance by the Owner. The phrase "make good" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All equipment, materials, accessories, etc. used shall be new and of current production unless specified otherwise. Equipment not specified in the Contract Documents shall be suitable for the intended use and shall be subject to approval by the Engineer.
- B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.
- C. All equipment shall bear the inspection label of Underwriters Laboratories Inc.
- D. All equipment and material for similar applications or systems shall be provided from the same manufacturer unless noted otherwise.
- E. Cast iron soil pipe and fittings shall bear the collective trademark of the Cast Iron Soil Pipe Institute.

2.2 ACCESS PANELS

- A. Manufacturers:
 - 1. Mifab.
 - 2. Acudor
 - 3. Elmdor
 - 4. Milcor
 - 5. PPP
- B. Group valves together above suspended ceilings, walls, furred spaces to minimize the number of access panels, but with all valves freely accessible for maintenance. Locate all valves within 1'-0" of access point. Minimum size requirements.
 - 1. 18"x18" for electrical related items.
 - 2. 24"x24" for plumbing isolation valves and electrical related items.
 - 3. 36"x24" for mechanical HVAC equipment.

- C. Furnish access panels of proper size to service concealed valves and cleanouts. Panels shall be of the proper type for material in which they occur and are to be furnished by the Contractor, but installed by the particular trade for the material within which the access panel is installed.
- D. Panels shall have flush doors with No.16 USCG steel door and trim No. 16 USCG steel frame, metal wings for keying into construction, concealed hinges, and screwdriver operated stainless steel cam lock. Panels shall be shop coated with one coat of zinc chromate primer. Valves above removable ceilings shall have tile clips by the Contractor for identification.
- E. Access panels are not allowed in gypsum ceilings in public spaces.

2.3 INSULATION

- A. The following shall be insulated:
 - 1. All domestic cold water piping above grade except at horizontal chase branch piping to individual plumbing fixtures.
 - 2. All domestic cold water piping above grade (15'-0" only from service entry). –
 - 3. All hot water and hot water return piping except at horizontal chase branch piping to individual plumbing fixtures.
 - 4. All horizontal storm drain piping and roof drain bodies.(SD and OD included)
 - 5. All water piping exposed to areas subject to freezing, refer to “Heat Cable for Freeze Protection of Piping” under Part 2.4 of Section 22 05 00 for additional requirements.
- B. Domestic hot, cold, hot water recirculation, primary storm drainage, and waste drainage piping shall be insulated with 4 lb. density sectional fiberglass insulation with a thermal conductivity not to exceed 0.24 with white all service jacket and vapor barrier. All joints and seams shall be sealed vapor tight. All seams and staples shall then be covered with “All Service Jacket” three-inch wide tape. Insulation shall be used for exposed piping.
- C. Materials as specified in this section shall be manufactured by Johns Manville Micro-Lok AP-T, Knauf ASJ/SSL, Owens Corning ASJ/SSL or equal. Insulation thicknesses shall be as shown in the following table below as minimum requirements. Where different thickness required by code or local jurisdiction, higher standard to be used:

Minimum Pipe Insulation			Insulation Thickness for Pipe Sizes				
Piping System Types	Fluid Temperature Range		1 in. and Less	1-1/4 to 2 in.	2-1/2 to 4 in.	5 and 6 in.	8 in. and Larger
	°C	F	In.	In.	In.	In.	In.
PLUMBING							
Domestic Water	Ambient	Ambient	0.5	1.0	1.0	1.0	--
Domestic Hot Water And Hot Water Recirculation	43-71	110-160	1.0	1.5	1.5	1.5	--
Above Grade Drains and Piping Receiving Condensate or Ice Machine Discharge	4.5-15.5	40-60	0.5	1.0	1.0	1.5	--
Horizontal Storm Drainage	Ambient	Ambient	--	--	1.0	1.0	1.0

- D. Insulate all horizontal storm drain piping with fiberglass insulation and with service jacket. For exposed locations provide 1" thick rigid insulation with rigid jacket. Insulate from roof drain body, past first elbow all the way to change to vertical direction, including y-fittings.
- E. All interior horizontal storm drainage piping systems and roof drain bodies are to be insulated with blanket type glass fiber bonded with thermosetting resin with white vinyl vapor retarding facing, 2" wide stapling/taping tab. Insulation shall be used in concealed spaces.
- F. Insulate all above slab horizontal sanitary waste piping carrying air-conditioning condensate with minimum 1"-1.5" fiberglass insulation with jacket from floor drain, including traps, all the way to change in direction to vertical.
- G. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).
- H. Aluminum Jacket:
 - 1. Jacket for piping shall be 0.016 inch thick type 3105 aluminum with factory applied one mil polykraft moisture barrier
 - 2. Fitting covers shall be factory made 0.024 inch type 1100 aluminum to match pipe covering.
 - 3. Aluminum jacketing shall be provided for all exposed piping.
 - 4. Manufacturers:
 - a. Childers
 - b. Pabco
 - c. RPR

2.4 HEAT CABLE FOR FREEZE PROTECTION OF PIPING

- A. Provide electric heat tracing on all domestic water piping and sanitary traps exposed to areas subject to freezing.
- B. Manufacturers:
 - 1. Thermon
 - 2. Emerson-Chromalox
 - 3. Pyrotenax
 - 4. Briscoe
 - 5. Raychem
- C. Provide a complete system of self-regulating heating cable on all domestic water piping in crawl spaces, un-conditioned attic spaces and outdoors and any other locations subject to freezing. System shall be UL Listed, CSA Certified, or FM Approved system of heating cables, components, and controls to prevent pipes from freezing.
- D. Electric heat cable shall be installed linearly along the bottom of the pipe and allowance shall be made for all fittings, valves, pipe supports, etc. Cable shall be installed prior to insulation of the piping system.
- E. Electric cable shall be capable of maintaining a minimum water temperature of 40 degrees F at an ambient air temperature of 0 degrees F.

- F. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core, which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.
- G. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 40 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized.
- H. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.
- I. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26 - Electrical Requirements.
- J. Electric heating cable shall be Raychem XL-Trace or approved equal, 5 watts per foot. Heat trace shall operate at 120 volts, A.C., without the use of transformers. Provide quantity of 120 volt branch circuits as required to serve heat trace load, maximum 1800 watts per circuit.
- K. All piping shall be insulated with 1" thick fiberglass insulation.
- L. Heating-cable circuit shall be protected by a ground-fault device for equipment protection. This requirement is in accordance with section 427-22 of the NEC-2002.
- M. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide pipe freeze protection. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires or that use crimps or terminal blocks, shall not be acceptable.

2.5 HEAT CABLE FOR TEMPERATURE MAINTENANCE OF PIPING

- A. Provide electric heat tracing on all domestic hot water piping to maintain the temperature of the water in the piping that is downstream of the hot water loop up to within 24" of the fixtures being served to meet all the mandates of the Green Code per the City of [Insert City Name].
- B. Manufacturers:
 - 1. Thermon
 - 2. Emerson-Chromalox
 - 3. Pyrotenax
 - 4. Briscoe
 - 5. Raychem
- C. Provide a complete system of self-regulating heating cable on all domestic hot water piping that is non-circulated. System shall be UL Listed, CSA Certified, or FM Approved system of heating cables, components, and controls to maintain water temperature.
- D. Electric heat cable shall be installed linearly along the top of the pipe when passing through pipe hangers and at the 4 or 8 o'clock position on linear runs and not compressed or pinched between two objects and allowance shall be made for all fittings, valves, pipe supports, etc. Penetrations through fire rated assemblies shall have its own

sleeve sealed with fire resistant material equal to STI firestop. Attach the cable to the pipe every two feet with RAYCHEM AT-180 pipe tape. Cable shall be installed prior to insulation of the piping and after all testing of the hot water system is complete.

- E. Electric cable shall be capable of maintaining a minimum water temperature of 105 degrees F and a maximum temperature of 140 degrees F, at an ambient air temperature of 50 degrees F.
- F. The electric cable shall be the self-regulating type that responds to varying localized temperature conditions by varying the heat output along its length. This shall be accomplished by a self-regulating core, which varies its resistance continuously with changes in temperature. A constant wattage heater is unacceptable.
- G. Provide a thermostat control, which de-energizes the heating cable when the ambient air temperature is above 100 degrees F (adjustable). The heat cable shall be entirely self-regulating while energized.
- H. Provide all power connection hardware, splices, end seals, etc., to accomplish installation. All hardware shall be by the same manufacturer as the cable.
- I. Electric heating cable and accessories shall be UL Listed. Electric heating cable shall conform to all requirements of Division 26 - Electrical Requirements.
- J. Electric heating cable shall be Raychem HWAT-R2 or approved equal. Heat trace shall operate at 208 or 277 volts, A.C., without the use of transformers. Provide quantity of 208 or 277 volt branch circuits as required to serve heat trace load.
- K. All piping shall be insulated with minimum of 1" thick fiberglass insulation for piping up to 1" in diameter, for larger piping consult manufactures guidelines.
- L. Heating-cable circuit shall be protected by an integral ground-fault system for the HWAT-ECO-GF AND ACS-30 control system, so no additional protection is required.
- M. All heating cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide water temperature maintenance. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall consist of a complete system of RayClic connection kits with a complete circuit that requires a power connection, an end seal and HWAT-ECO-GF controller to ensure proper water temperature. Splices and tees and other connection kits are used as needed. Installation shall be as recommended by the manufacturer.

2.6 FLASHING

- A. Vent pipes passing through roof shall be flashed watertight.
- B. The roof connections shall meet the approval of the manufacturer of the roofing materials and shall comply with the roof bond requirements.
- C. All vent piping shall be offset above ceilings or in attic space and as shown on the Drawings to penetrate roofs on the least visible sides of building.

2.7 FLOOR, WALL & CEILING PLATES

- A. Furnish and install heavy gauge chromium plated steel wall and ceiling plates on all exposed pipes in finished areas where they pass through walls, ceilings, etc. Plates shall be of type that will remain permanently in position and where pipes are insulated they shall be of size necessary to cover insulated pipe.

2.8 DRAIN PAN

- A. Furnish and install 18 - 24 ga galvanized steel pan under all plumbing pipes in the electrical room, IDF, and pan for the water heater. A drain pan shall have at least 2" in depth and extend 6" beyond the pipe or equipment.
- B. The drain pan shall be installed at least 6'-0" above electrical panel and gear access clearance and minimum within 6" below the pipe. Run copper drain line into the nearest floor receptacle or provide a float switch interface with BAS as applicable.
- C. Provide steel Unistrut and hanger for the drain pan support.
- D. Manufactures:
1. Diversitech
 2. Killarney Metals
 3. Eastman
 4. Riverside Sheet Metal

2.9 TRACER WIRE

- A. General:
1. All trace wire and trace wire products shall be domestically manufactured in the U.S.A.
 2. All trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.
 3. All trace wire shall be provided for mains 4" and larger.
 - a. Wire shall be installed in the trench on top of the underground plastic piping and then attached to metal pipe above slab at the end of the run. The wire shall extend max 5'-0" outside the building to an access point, refer to Termination/Access for specified box.
 - 1) Access point shall be located such that it is easily accessible for maintenance personnel and in coordination with the surrounding Architectural and Civil elements.
- B. Trace wire: (Copper clad Steel (CCS) trace wire)
1. Open-Trench Installation: direct burial #12 AWG Solid (0.0808" diameter), steel core soft drawn tracer wire, 250# average tensile break load, 30 mil high molecular-high density polyethylene jacket complying with ASTM-D-1248, 30volt rating. Color shall be "blue" for domestic water (potable) pipelines and "purple" for raw water (non-potable) pipelines. Manufactured by Copperhead Industries part number 1230-SF, or approved equal.
 2. Directional Bore or Jacked Installation: direct burial #12 AWG Solid (0.0808" diameter), steel core hard drawn extra high strength horizontal directional drill tracer wire, 1150# average tensile break load, 45 mil high molecular-high density polyethylene jacket complying with ASTM-D-1248, 30 volt rating. Color shall be "blue" for domestic water (potable) pipelines and "purple" for raw water (non-

potable) pipelines. Manufactured by Copperhead Industries part number 1245-HS, or approved equal.

- C. Connectors: (Copper clad Steel (CCS) trace wire)
1. Splices along the continuous run of trace wire for repair of a wire break or replacement of failed segment of wire shall use 3M Brand DBR Direct Bury Splice Kit or approved equal. Approved alternatives must securely connect two or more wires, effectively moisture seal by means of a dielectric non-hardening silicone sealant, manufacturer approved for direct burial and rated for a minimum of 50V.
 2. Branch connections for laterals, turnouts, services and appurtenances shall use DryConn Direct Bury Lug Aqua, or approved equal. Approved alternatives must securely connect one or two wires to the main trace wire without cutting the main trace wire, effectively moisture seal by means of a dielectric non-hardening silicone sealant, manufacturer approved for direct burial and rated for a minimum of 50V.
 - a. The intent of this specification is to provide connection terminations at main branches serving separate buildings, separate sections of a building, turnouts, services, and appurtenances. The tracer wire shall be capable of continuing along all under slab main runs such that, when energized, the resulting tone continues for that part of the associated segment of the underground system.
 3. Non-locking, friction fit, twist-on or taped connectors are not acceptable. Twisting of copper wiring is not acceptable.
- D. Termination/Access: (Copper clad Steel (CCS) trace wire)
1. Terminal box (otherwise known as a terminal “well”) shall be located at five (5) feet outside the building to terminate the tracer wire. Provide SnakePit Access Point by Copperhead Industries or equivalent product by alternative manufacturer that is compatible with the completed tracer wire system.
 2. Terminal box, or “fink box”, shall be flush mount type for installation at grade level. Terminal box shall be specifically manufactured for such application.
 3. Terminal Box shall consist of tubular housing, terminal board and removable round lid.
 4. Minimum dimensions shall be 5-1/2” diameter and 8” high. Base shall be sized to fit 4” schedule 40 PVC pipe.
 5. Housing and terminal board material shall be high strength ABS or polycarbonate plastic. All materials of construction shall be impervious to chemicals typically used for snow and ice removal and pavement and hardscape maintenance.
 6. Housing and lid shall be designed for service
 - a. Turf and landscape areas
 - 1) Light duty housing with plastic lid
 - b. Hardscape areas
 - 1) Heavy duty housing with cast iron or ductile iron lid
 - c. Roadway, driveway and parking lot applications not allowed
 7. Terminal board shall have nickel plated brass terminals. Number of terminals shall be as required for specific installation with four spare terminals, minimum.
- E. Grounding: (Copper clad Steel (CCS) trace wire)
1. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20ft of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 0.5 lb.) specifically manufactured for this purpose, and buried at the same elevation as the utility.
 2. Drive in Magnesium Anode: Copperhead Part # ANO-1005 (1.5 lb).

2.10 PIPING SYSTEMS IDENTIFICATION

- A. A marker showing the service and an arrow indicating the direction of flow shall be applied on all of the following piping systems applicable to the project installed under this section of the Specifications:
1. Acid vent piping
 2. Acid waste piping
 3. Compressed air piping
 4. Condensate
 5. Domestic hot, cold and hot water recirculation water piping
 6. Di and Di water recirculation water piping
 7. Fuel oil piping
 8. Gas piping
 9. Storm drainage piping
 10. Overflow storm drainage piping
 11. Sanitary, waste and vent piping
 12. Softened water piping
 13. Steam piping
 14. Vacuum piping
 15. Non-potable water piping
- B. Piping identification shall be applied on all piping systems in areas of exposed construction and in areas with accessible or lay-in ceilings, as well as in the following locations:
1. Each wall, floor, and ceiling penetration (both sides).
 2. At connections to equipment.
 3. Close to valves or flanges.
 4. Intervals on straight pipe runs not to exceed 25 feet.
 5. Apply marker where view is obstructed.
- C. No adhesive labels shall be permitted, only “snap-around” or “snap-on” labels shall be permitted.
- D. The letter size and background color shall conform to the Identification of Pipe System ANSI A-13-1. Identify interior exposed piping and piping in accessible chases or plenums with a non-adhesive label by a manufacturer noted below, consisting of pipe marker and direction of flow arrow. Clean pipe prior to installation. Pipe markers shall consist of pipe system type and direction of flow arrow. Background colors of markers, arrows, and type for each type of system shall be the same. Meet ANSI / OSHA standards and clearly identify each system. Minimum 2-1/4-inch letters through 4-inch pipe and 4-inch letters for 5-inch pipe and larger.
1. Vinyl plastic markers shall be manufactured by Seton Name-Plate Company (Snap-Around), W.H. Brady Company (Snap-On), or Westline “Tel-A-Pipe” Products (Snap-Around).
- E. Each valve in the Plumbing and Fire Protection systems is to be provided with an individually numbered valve tag (stamped numbered tags). Provide Identification Tags on all Emergency fixture and unit or Shut off valves.
- F. Valve tags are to be brass or plastic laminate, 1-1/2” minimum diameter with brass chain and hook for securing to the valve.

- G. Valve tags will include a “P” or “FP” lettering designation to indicate the appropriate system. Numbering shall be consecutive for each service of either the Plumbing or Fire Protection systems.
- H. A printed list or schematic drawing shall be compiled for each system indicating the location and detailed description of the system or equipment served.
- I. One copy of each list shall be framed and mounted at the location designated by the Building Engineer. An additional copy of each list is to be included in the Operations and Maintenance Manual.

2.11 EQUIPMENT LABELING

- A. All equipment shall be labeled. This shall include all pumps, water heaters, storage tanks, utility controllers and other similar equipment.
- B. Equipment labeling shall be with the followings, unless noted or specified otherwise.
 - 1. Submit schedule of equipment to be included and designations.
 - 2. Provide nameplates with 1/2" high letters and fastened with epoxy or screws.

PART 3 - EXECUTION

3.1 OWNER INSTRUCTION - GENERAL

- A. Provide on-site Owner training for all new equipment by factory trained specialists.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.
- D. No retainage shall be released until Owner has received all Operations and Maintenance manuals and as-built drawings and first O&M walk.
- E. Refer to individual equipment specifications for additional training requirements.
- F. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections.
- G. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed at such times and in such a manner as to avoid damage and as required by the job progress. The Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical and architectural work. Equipment, accessories and similar items requiring normal servicing or maintenance shall be accessible.
- H. The Engineer reserves the right to direct the removal of any item which, in his opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.
- I. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

3.2 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to final inspection, conduct an on-site training program to instruct the Owner's operating personnel in the operation and maintenance of the mechanical systems.
 - 1. Provide the training during the Owner's regular working day.
 - 2. The Instructors shall each be experienced in their phase of operation and maintenance of building mechanical systems and with the project.

- B. Time to be allocated for instructions.
 - 1. Minimum of 8 hours dedicated instructor time.
 - 2. 4 hours on each of 2 days.

- C. Before proceeding with the on-site training program, submit the program syllabus; proposed time and dates; and other pertinent information for review and approval.
 - 1. One copy to the Owner.
 - 2. One copy to the Architect/Engineer.

- D. The Owner will provide a list of personnel to receive instructions, and will coordinate their attendance at the agreed upon times.

- E. Use the operation and maintenance manuals as the basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shut down of each item of equipment.

- G. Demonstrate equipment functions (both individually and as part of the total integrated system).

- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.

- I. Submit a report within one week after completion of the training program that instructions have been satisfactorily completed. Give time and date of each demonstration and hours devoted to the demonstration, with a list of people present.

- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he/she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.

- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each "Operation and Maintenance Manual":

3.3 GENERAL REQUIREMENTS

- A. All equipment and materials shall be completely installed, adjusted, and fully operational with all accessories and connections.

- B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed at such times and in such a manner as to avoid damage and as required by the job progress. The Contractor shall coordinate work with other trades and

locate work described herein to avoid interferences with structural, electrical and architectural work. Equipment, accessories and similar items requiring normal servicing or maintenance shall be accessible.

- C. The Engineer reserves the right to direct the removal of any item which, in his opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Engineer and without additional cost to the Owner.
- D. Mounting heights, unless otherwise noted, are to the finished bottom of the device.

3.4 STORAGE AND PROTECTION OF MATERIALS

- A. During construction, all equipment shall be properly protected against damage, defacing and freezing with shipping cartons, plastic sheeting, shipping covers, etc.
- B. All open ends of piping and equipment shall be sealed with nipples and caps, plugs, test plugs until final connection to system is made.
- C. All equipment and piping shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction with covers by Sioux Chief, Zurn or the followings.
 - 1. Floor sink opening – Cover with heavy duty plywood or heavy-duty plastic cover by SmartGuard (using duct tape is not acceptable).
 - 2. Floor drain – Plastic cover by SmartGuard, Mifab allstar or equal (using duct tape is not acceptable).
 - 3. Pipe – Plastic cover by SmartGuard or equal (using duct tape is not acceptable).
 - 4. Fixtures – Provide plastic cover until final punch.
 - 5. Clean-out top - Mifab allstar or equal (using duct tape is not acceptable)
- D. Handle and store materials in accordance with manufacturer's and supplier's recommendations and in manner to prevent damage to materials during storage and handling. Replace damaged materials.
- E. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

3.5 EXISTING WORK

- A. Disconnect mechanical, plumbing and fire protection systems in walls, floors, and ceilings scheduled for removal.
- B. Provide all required connections to maintain existing systems in service during construction.
- C. When performing work on operating systems use personnel experienced and trained in similar operations.
- D. Remove, relocate, and extend existing installations to accommodate new construction.

- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Normal facility activities will continue in existing areas. MEP systems servicing existing occupied spaces will have to be maintained in service. Schedule any required outages and system service interruptions with Owner and Architect. Submit a written request indicating service(s) to be interrupted along with proposed duration and summary of work to be performed during downtime.
- G. Removed Equipment:
 - 1. Store removed items at site; Owner retains rights to all removed items.
 - 2. Allow Owner ample time to review removed items and to designate which items to be kept by Owner.
 - 3. Dispose properly, off-site, all items Owner chooses not to keep.

3.6 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

- A. Remove, relocate and extend existing installations to accommodate new construction.
- B. Remove abandoned piping to source of supply.
- C. Remove exposed abandoned piping systems, including abandoned systems above accessible ceiling finishes. Cut systems flush with walls and floors, and patch surfaces.
- D. Repair adjacent construction and finishes damaged during demolition and extension work.
- E. Maintain access to existing installations which remain active. Modify installation or provide access panels as appropriate.
- F. Extend existing installations using materials and methods compatible with existing installations, or as specified.

3.7 REMOVAL OF MATERIALS

- A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage destination as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The contractor may, at his discretion and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.
- B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involves.
- C. When items scheduled for relocation are found to be in damaged condition before work has been started on dismantling, the contractor shall call the attention of the Owner to

such items and receive further instructions before removal. Items damaged in repositioning operations are the contractor's responsibility and shall be repaired or replaced by the contractor as approved by the Owner, at no additional cost to the Owner.

- D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.
- E. Include in the contract price all rerouting of existing conduits, wiring, outlet boxes, fixtures, etc., and the reconnecting of existing fixtures as necessitated by field conditions to allow the installation of the new systems. Furnish all temporary conduit, wiring, boxes, etc., as required to maintain lighting and power service for the existing areas with a minimum of interruption. Remove wire and conduit back to nearest accessible active junction box and extend to existing homeruns as required.
- F. The Contractor shall be responsible for loss or damage to the existing facilities and shall be responsible for repairing such loss or damage. The Contractor shall send proper notices, make necessary arrangements, and perform other services required for the care, protection and operational maintenance of all electrical services for the new and existing facilities, The Contractor shall erect temporary barricades, with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.
- G. Where existing construction is removed to provide working and extension access to existing utilities, Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.
- H. Where partitions, walls, floors, or ceilings of existing construction are being removed, all contractors shall remove and reinstall in locations approved by the Architect all devices required for the operation of the various systems installed in the existing construction

3.8 EXCAVATION, TRENCHING & BACKFILLING

- A. The Contractor shall perform all excavation to install the work herein specified and as indicated on the Drawings. During excavation, material for backfilling shall be piled back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. All excavated materials not to be used for backfill shall be removed and disposed of by the Contractor. Grading shall be done to prevent surface water from flowing into trenches and others excavation and any water accumulating therein shall be removed by pumping. All excavation shall be made by open cut. No tunneling or boring shall be done except under pavement.
- B. The bottom of the trenches shall be graded to provide uniform bearing and support for conduits, cables, or duct bank on undisturbed soil at every point along its entire length. Overdepths shall be backfilled with loose, granular, moist earth, and tamped in 12" layers. Remove unstable soil that is not capable of supporting equipment or installation

and replace with specified material for a minimum of 12" below invert of equipment or installation.

- C. The Contractor shall coordinate and provide pipe supports as required per structural drawings for any void form system, exiting the building or special requirements on backfill. As such, all piping shall be supported by an approved suspended system.
1. System Structure:
 - a. Provides a dimensionally stable underground void space that is independent from the overhead structural slab. The subterranean system shall support the weight of suspended lateral pipes, including all imposed loads, throughout the construction process.
 - b. The system shall be designed to have the ability to temporarily position and suspend the lateral pipes to the specified height and slope until permanently anchored to the overhead structural slab via securing hanger system. The open, underground system will then remain independent from the securing hangers.
 - c. The open space of the system beneath the structural slab is design to receive infill of vertical expansion from the underlying soils. If vertical pressure is applied to the edges of the system in contact with the soil, the uplifting soil pressure will become separate and allow the lateral pipes to be totally independent from the system.
 2. System components:
 - a. The system must maintain its structural integrity in all humid environment and shall have waterproof components related to its intended performance. All system components, excluding all-thread, nuts/washer. Shall be furnished by the designed, system manufacturer.
 - b. All vertical all-thread must have a component secured toward the top end and the permanent affixed into the concrete slab in order to maintain the specified elevations.
 - c. System shall be installed per manufacturer's requirements and recommendations.
- D. The trenches shall be backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and tamped until the crown of the pipe is covered by a minimum of 6" of tamped earth. The backfill under and beside the pipe shall be compacted for pipe support. Backfill shall be brought up evenly on both sides of the pipe so that the pipe remains aligned. In instances where the manufacturer's installation instructions for materials are more restrictive than those prescribed by the code, the material shall be installed in accordance with the more restrictive requirement. The backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. The compaction of the filled trench shall be at least equal to 95% of the maximum density as determined by the Standard Proctor Test. Settling the backfill with water will not be permitted. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore the surface to the grade and compaction indicated, mounded over and smoothed off. A metallic lined underground warning tape shall be provided 12" below finished grade. The tape shall be identified as to the type of line per ANSI standard nomenclature and color.

- E. The trenches shall be backfilled with cement stabilized sand materials approved for backfilling, deposited in 6" layers and tamped until the crown of the pipe is covered by a minimum of 6" of material.
1. Use sand-cement mixture producing minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours.
 - a. Design will be based on strength specimens molded in accordance with ASTM D 558 at moisture content within 3 percent of optimum and within 4 hours of batching.
 - b. Determine minimum cement content from production data and statistical history. Provide no less than 1.1 sacks of cement per ton of dry sand.
 2. Cement: Type I Portland cement conforming to ASTM C 150.
 3. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C 33, or requirements for bank sand below, and the following requirements:
 - a. Classified as SW, SP, SW-SM, SP-SM, or SM by Unified Soil Classification System of ASTM D 2487.
 - b. Deleterious materials:
 - 1) Clay lumps, ASTM C 142 - less than 0.5 percent.
 - 2) Lightweight pieces, ASTM C 123; less than 5.0 percent.
 - 3) Organic impurities, ASTM C 40, color no darker than standard color.
 - 4) Plasticity index of 4 or less when tested in accordance with ASTM D 4318.
- F. Provide a layer of sand at least 6" deep under all plastic pipe installed in soil. Bell holes shall be excavated to ensure that the sewer pipe rests for its entire length upon a solid trench bottom.
- G. Tracer wires shall be installed adjacent to nonmetallic underground water, gas and main sewage lines under the building pad and stubbed up into a ground test well enclosure so that the tracer can connect to it. Tracer wire shall be color coded; yellow for natural gas; green for storm and sanitary sewer; and blue for potable water.
1. Installation:
 - a. Trace wire shall be installed in the same trench and inside bored holes and casing with pipe during pipe installation. It shall be secured to the pipe as required to insure that the wire remains adjacent to the pipe. The trace wire shall be securely bonded together at all wire joints with an approved watertight connector to provide electrical continuity, and it shall be accessible at all trace wire access points.
 - b. Except for approved spliced-in repair or replacement connections, tracer wire shall be continuous and without splices from each trace wire access point.
 - c. The tracer wire system shall be installed as a continuous single wire. No looping or coiling of wire is allowed.
 - d. Prior to backfill, install tracer wire on top of pipe and secure in place with ties or hitches at maximum 10-foot intervals in accordance with the Water Utilities Manual. Run tracer wire continuously along pipe and terminate in access points. Only adjacent valve boxes are acceptable access points. Where buried splices occur, use an electrical splicing kit 3M Brand DBR Direct Bury Splice Kit, or AGENCY approved equal. Provide no less than 24 inches of coiled wire at access points for attachment of pipe locating equipment. Each installed run of pipe shall be capable of being located using the tracer wire. Protect wire insulation from damage during installation and backfilling. Wire insulation that is broken, cut, or damaged shall be replaced.

- e. At the point of connection between existing conductive pipes, the tracer wire shall not be connected to the iron pipe. This circumstance shall be treated as a mainline dead-end grounded using an approved waterproof connection to a grounding anode, buried at the same depth as the tracer wire. All such connection points shall be grounded.
- f. Where existing tracer wire is encountered on an existing utility that is being extended or tied into, the new and existing tracer wire shall be connected using approved splice connectors, shall be properly grounded at the splice location as specified, and shall be completely waterproof to prohibit corrosion and loss of conductivity.
- g. Tracer wire shall be laid flat and securely affixed to the pipe at the three o'clock position. The wire shall be protected from damage during the execution of the works. No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. At service saddles, the tracer wire shall not be allowed to be placed between the saddle and the main.
- h. At all main end caps, a minimum of 6 feet of tracer wire shall be extended beyond the end of the pipe, coiled and secured to the cap for future connections. The end of the tracer wire shall be spliced to the wire of a six pound zinc anode and is to be buried at the same elevations as the main. The tracer wire from the end cap shall be brought to a surface into test station box within the public right-of-way for future access.
- i. Trace wire access points shall be accessible at all new water valve boxes. Concentrations of multiple proposed valves near pipe intersections, i.e. tees or crosses, may require more than one access point assembly in each concrete valve box collar.
- j. At the point of connection between ductile iron water mains, with any non iron main, the tracer wire shall be properly connected to the iron pipe with a cad weld or approved equivalent. Tracer wire welds shall be completely sealed with the use of an approved mastic type sealer specifically manufactured for underground use. Mastic shall be applied in a thick coat a minimum of one quarter inch (1/4") thick and shall be protected from contamination by the backfill material with the use of a plastic membrane.
- k. Trace wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
- l. Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire, and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
- m. Open trench method:
 - 1) Tracer wire shall be placed a minimum of 8 inches above buried natural gas piping and nonmetallic piping for any service. For other utility piping systems tracer wire shall be laid directly upon pipe and attached at 8-10 ft. intervals with non-conductive tape. Additional attachment shall be provided at offsets and fittings in piping system. Tracer wire shall be placed carefully and great care shall be exercised during backfilling operations to maintain physical integrity and position relative to piping.
 - 2) Splices in tracer wire shall be kept to an absolute minimum. When splices are necessary they shall be made with tracer wire connectors as specified above. Other splicing methods not allowed.
- n. Directional drilling method:

- 1) Two tracer wires shall be provided with one wire as backup.
 - 2) Tracer wires shall be pulled through bore hole in conjunction with utility pipe. Wires shall be located on opposite sides of utility pipe.
 - 3) Tracer wire splices are not allowed in drilled sections.
- o. Tracer wires shall be interconnected at intersections of mainlines and branches utilizing single three-way connector at each point of connection.
 - p. At a minimum, a terminal box shall be provided at each building utility service entrance and shall be located above piping within 5 ft. of point of entry into building.
 - q. Terminal boxes shall be located no greater than 1,000 linear feet of developed pipe length apart.
 - r. Terminal boxes shall not be located in streets, drives, parking lots or other areas subject to vehicular traffic. Terminal boxes shall not be located in areas where access to box is impeded.
 - s. Terminal boxes shall be installed flush with finished grade and centered in grade level concrete pad. Concrete pad shall be 18" by 18" minimum and shall be 6" thick.
 - t. PVC pipe riser shall be firmly attached to bottom of terminal box housing and extended downward to an elevation approximately 12" above piping. Riser shall serve as a vertical conduit for guiding tracer wires into bottom of terminal box.
 - u. Care shall be taken to extend tracer wire from utility pipe to terminal box in an orderly manner as backfill is placed.
 - v. End of each tracer wire shall be properly landed on dedicated terminal within terminal box and securely tightened. 12-18" excess length shall be provided for each wire within box. Each terminal shall be clearly identified with permanent label. Where tracer wires for multiple utilities are terminated care shall be taken to ensure accuracy of identification at both ends.
2. Testing:
 - a. All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership.
 - b. This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.
 - c. Final testing of each tracer wire shall be performed after backfill is complete and terminal boxes have been permanently installed and wires terminated. Test shall be witnessed by AE and Owner. It may be advisable for Contractor to perform preliminary test(s) during utility installation prior to final backfill and restoration. Testing shall be accomplished using typical low frequency line tracing equipment. Continuity testing in lieu of actual line tracing is not acceptable.
- H. Perform excavation and backfilling work in accordance with applicable portions of the earthwork section.

3.9 CONCRETE WORK

- A. Construct curbs, pads, vaults and similar supports for equipment where required.

- B. First floor and equipment yard: Provide minimum of 6" thick housekeeping pads at floor mounted equipment a minimum of 4" larger than the entire area occupied by equipment. The pads at the equipment yard must be elevated at 6" above finished floor (1st floor).
- C. Second floor and above: Provide 4" thick housekeeping pads at floor mounted equipment a minimum of 4" larger than the entire area occupied by equipment. Dowel pads to structural slab.
- D. Perform concrete work in accordance with applicable portions of Concrete sections. Minimum compressive strength of concrete shall be same as specified for slabs on grade.

3.10 CLEANING

- A. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge and circulate.
- B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, etc. shall be thoroughly cleaned both inside and out with the following minimum requirements.
 - 1. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow down ball valve and pipe to nearest drain. Blow down strainers, remove and clean as frequently as necessary.
 - 2. Phase One: Initial flushing of system. Remove loose dirt, mill scale, weld beads, rust and other deleterious substances without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until "potable water clear" and particles larger than 5 microns are removed.
 - 3. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
 - 4. Dispose of water in approved manner.
 - 5. Phase Two: Cleaning of Piping Systems. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), soldering flux, mill varnish, piping compounds, rust (iron oxide) and other deleterious substances not removed by initial flushing. Flush system and replace with clean water.
 - 6. Phase Three: Final flushing and rinsing: Flush and rinse until "potable water clear" and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.
 - 7. Submit status reports upon completion of each phase of work on each system.
- C. After testing and balancing of systems as specified and just prior to Owner review and acceptance, all systems shall be finally cleaned and shall be left ready for use.

3.11 TESTING OF PIPING SYSTEMS

- A. General
 - 1. All piping systems shall be subjected, before being insulated or concealed, to testing with water or air as noted and shall hold tight at the pressure head stated

for the time interval required without adding air or water. While any system is being tested required head or pressure shall be maintained until all joints are inspected.

2. All tests shall be witnessed by the inspector having jurisdiction and the Owner's Representative, with a minimum 48-hour notice given these authorities.
3. All equipment, material, labor and testing mediums required for testing any of the various systems or any part thereof shall be furnished by the Contractor.
4. All connected equipment, accessories, etc. shall be isolated from piping systems prior to testing.

B. Sanitary Piping Systems

1. Water test shall be applied to these drainage systems either in their entirety or in sections as required, after rough piping has been installed. If the system is tested in sections, each opening shall be tightly closed except the highest opening in the section under test. All sections shall be tested with a minimum of 10 feet of head. In testing successive sections, at least the upper 10 feet of the next section shall be tested so that no joint of piping in the building shall be submitted to a test of less than 10 feet of head. The water shall be kept in the system for at least 30 minutes before inspection starts; the system shall then be made tight at all points.
2. Any points of the drainage systems to be tested with air instead of water shall be made by attaching an air compressor testing apparatus to any suitable opening and after closing all other inlets or outlets, forcing air into the system until there is a minimum gauge pressure of 5 psi. This pressure shall be held without the introduction of additional air for a period of at least 30 minutes.
3. Exterior connections shall be tested as part of the interior systems.

C. Interior Water Piping Systems

1. Upon completion of the entire water supply system or a section of it as required, it shall be tested prior to connection of fixtures and proved tight under a water/air pressure of 150 psi. Pressure shall hold for a period of one hour without introducing additional water/air. Water used for testing shall be from a potable source of supply. Defective joints or piping shall be replaced as required and all piping shall be retested.

D. Exterior Water Piping System

1. All exterior domestic water piping shall be tested to 150 psi for a period of two hours.

E. Compressed Air System

1. All compressed air piping shall be tested to 150 psi for a period of two hours.

F. Vacuum System

1. All vacuum system piping shall be tested to 100 psi for a period of two hours

G. Defective Work

1. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. All repairs to piping shall be made with new material. Caulking of screwed joints or holes is not acceptable.

H. Additional Tests

1. Provide all additional tests such as smoke or pressure tests as required by the regulations or as directed by authorities making the inspection.
2. Provide for any repeated test as directed by the Owner's Representative, to make all systems tight as required.
3. Visual inspections of joints, valves, etc. shall be made as directed by the Engineer.

3.12 OPERATING TESTS

- A. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect/Engineer. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

3.13 DISINFECTION OF WATER SYSTEM - INTERIOR AND EXTERIOR

- A. Prior to project completion, all potable water piping systems shall be disinfected per local code requirements.
- B. Whenever the authority having jurisdiction does not specify disinfection procedures, the new water piping system shall be thoroughly disinfected with a solution containing not less than 50 parts per million of available chlorine. The chlorinating material shall be either liquid chlorine or sodium hydrochloride solution, shall be introduced into the system and drawn to all points in the system. The disinfection solution shall be allowed to remain in the system for a period of eight hours, during which period all valves and faucets shall be opened and closed several times. After disinfection, the solution shall be flushed from the system with clear water until the residual chlorine content is not greater than 0.2 parts per million.
- C. This work is to be supervised or performed by an approved chemical testing laboratory and results sent to Engineer or his representative for verification.

3.14 OPERATION AND MAINTENANCE MANUALS

- A. Form of Manuals:
1. Prepare data in form of an instructional manual for use by Owner's personnel.
 2. Format:
 - a. Size: 8-1/2" x 11".
 - b. Text: Manufacturer's printed data or neatly typewritten
 3. Drawings:
 - a. Provide reinforced punched binder tab and bind in text.
 - b. Fold larger drawings to size of text pages.
 4. Provide fly leaf indexed tabs for each separate product or each piece of operating equipment

5. Cover: Identify each volume with typed or printed title "Operating and Maintenance Instructions". List:
 - a. Title of Project
 - b. Identity of separate structures as applicable.
 - c. Identity of general subject matter covered in the manual
 6. Binder as specified.
- B. Content of Manual:
1. Neatly typewritten Table of Contents for each volume arranged in systematic order as outlined in the specifications.
 - a. Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to content of the volume.
 - c. List with each product, name, address and telephone number of:
 - 1) Subcontractor or installer
 - 2) Maintenance contractor as appropriate.
 - 3) Identify area of responsibility of each
 - 4) Local source of supply for parts and replacement
 - d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
 2. Product Data:
 - a. Include those sheets pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.
 - 3) Delete references to inapplicable information. (All options not supplied with equipment shall be marked out indicated in some manner).
 3. Drawings:
 - a. Supplement product data with drawings as necessary to illustrate:
 - 1) Relations of component parts of equipment and systems.
 - 2) Control and flow diagrams.
 - b. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Written text, as required to supplement product data for the particular installation:
 - a. Organize in consistent format under separate headings for different procedures.
 - b. Provide logical sequence of instructions for each procedure.
 5. Copy of each warranty, bond and service contract issued.
 - a. Provide information sheet for Owner's personnel, giving:
 - 1) Proper procedures in event of failure.
 - 2) Instances that might affect validity of warranties or bonds
 6. Shop drawings, coordination drawings and product data as specified.
- C. Sections for Equipment and Systems
1. Content for each unit of equipment and system as appropriate:
 - a. Description of unit and component parts
 - 1) Function, normal operating characteristics, and limiting conditions.
 - 2) Performance curves, engineering data and tests.
 - 3) Complete nomenclature and commercial number of replaceable parts
 - b. Operating procedures:
 - 1) Start up, break-in, routine and normal operating instructions.

- 2) Regulation, control, stopping, shut down and emergency instructions.
 - 3) Summer and winter operating instructions.
 - 4) Special operating instructions
 - c. Maintenance procedures:
 - 1) Routine operations
 - 2) Guide to trouble-shooting.
 - 3) Disassembly, repair and reassembly.
 - 4) Alignment, adjusting and checking.
 - 5) Routine service based on operating hours.
 - d. Servicing and lubrication schedule. List of lubricants required.
 - e. Manufacturer's printed operating and maintenance instructions.
 - f. Description of sequence of operation by control manufacturer
 - g. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
 - 1) Predicted life of part subject to wear.
 - 2) Items recommended to be stocked as spare parts.
 - h. As installed control diagrams by controls manufacturer.
 - i. Complete equipment internal wiring diagrams.
 - j. Each Contractor's coordination drawings.
 - k. As installed color coded piping diagrams.
 - l. Charts of valve tag number, with location and function of each valve.
 - m. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
 - n. Other data as required under pertinent sections of the specifications.
2. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel.
 3. Additional requirements for operating and maintenance data as outlined in respective sections of specifications
 4. Provide complete information for products specified in Division 22.
 5. Provide certificates of compliance as specified in each related section.
 6. Provide start up reports as specified in each related section.
 7. Provide signed receipts for spare parts and material.
 8. Provide training report and certificates.
 9. Provide backflow preventer certified test reports.
 10. Provide gas piping pressure test report.

END OF SECTION 22 05 00

SECTION 22 05 16 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Expansion joints.
 - 2. Pipe alignment guides.
 - 3. Pipe anchors.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for piping hangers and supports.

1.3 DESIGN REQUIREMENTS

- A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.
- B. Expansion Compensation Design Criteria:
 - 1. Installation Temperature: 50 degrees Fahrenheit.
 - 2. Domestic Hot Water: 140 degrees Fahrenheit.
 - 3. Safety Factor: 30 percent.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints. Submit shop drawings sealed by a registered professional engineer.
- C. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- D. Design Data: Indicate criteria and show calculations. Submit calculations sealed by a registered professional engineer.
- E. Manufacturer's Installation Instructions: Submit special procedures.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

- G. Welders' Certificate: Include welders' certification of compliance with AWS D1.1.
- H. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- B. Operation and Maintenance Data: Submit adjustment instructions.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.
- B. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
- B. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY

- A. Furnish five (5) year manufacturer warranty for leak free performance of packed expansion joints.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

- A. Manufacturers:
 - 1. Amber / Booth
 - 2. Triplex
 - 3. Mason Industries
 - 4. Uponor
- B. Stainless Steel Bellows Type:
 - 1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
 - 2. Maximum Compression: 1-3/4 inch.
 - 3. Maximum Extension: 1/4 inch.
 - 4. Joint: As specified for pipe joints.
 - 5. Size: Use pipe sized units

6. Application: Steel piping three (3) inch and smaller.
- C. External Ring Controlled Stainless Steel Bellows Type:
1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
 2. Maximum Compression: 15/16 inch.
 3. Maximum Extension: 5/16 inch.
 4. Maximum Offset: 1/8 inch.
 5. Joint: Flanged
 6. Size: Use pipe sized units
 7. Accessories: Internal flow liner.
 8. Application: Steel piping three (3) inch and larger.
- D. Double Sphere, Flexible Compensators:
1. Body: Multi-layered Kevlar tire cord fabric reinforced with EPDM cover, liner and fabric frictioning with reinforcing ring.
 2. Working Pressure: 215 psi
 3. Maximum Temperature: 250 degrees Fahrenheit.
 4. Maximum Compression: 1-1/4 inch through 6 inch pipe; 1-1/2 inch 8 inch through 12 inch; 1-1/5 inch for 14 inch.
 5. Maximum Elongation: 3/4 inch through 6 inch pipe; 1-1/2 inch 8 inch through 12 inch; 5/8 inch for 14 inch.
 6. Maximum Offset: 3/8 inch through 6 inch pipe; 7/8 inch 8 inch through 12 inch; 1 inch for 14 inch.
 7. Maximum Angular Movement: 15 degrees.
 8. Joint: Steel flanges or ductile iron pipe flanges.
 9. Size: Use pipe sized units
 10. Accessories: Control rods.
 11. Application: Steel piping two (2) inch and larger.
- E. PEX-a Pipe Support (Uponor):
1. For use with Uponor PEX-a pipe
 2. PEX-a pipe continuously supported with PEX-a Pipe Support and utilizing fixed anchor points every:
 - a. 65 feet for domestic hot water
 - b. 150 feet for domestic cold water
 3. Utilize the included stainless-steel straps to secure the PEX-a Pipe Support to the pipe at the intervals specified in the manufacturer's installation instructions.
 4. Refer to the Uponor Plumbing Design Assistance Manual for more information.

2.2 ACCESSORIES

- A. Manufacturers:
1. Amber / Booth
 2. Triplex
 3. Mason Industries
- B. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine piping layout and notify the Architects/Engineers of additional anchors or expansion joints required to adequately protect system.
- B. Provide inspection services by flexible pipe manufacturer's representative for final installing and certify that installation is in accordance with manufacturer's recommendations and that connectors are performing satisfactorily.

3.2 INSTALLATION

- A. Install Work in accordance with ASME B31.9.
- B. Install piping to allow for expansion and Contraction without stressing pipe, joints or connected equipment.
- C. Flexible piping shall not be used in concealed spaces. Access panel shall be provided for concealed space installation.
- D. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. Refer to Section 23 05 29 for pipe hanger installation requirements.
- E. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.
- F. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.
- G. Provide expansion loops as per pipe manufacturers design guideline or as indicated on Drawings. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so that movement takes place along axis of pipe only. Rigidly anchor pipe to building structure to prevent stresses and transfer of loading to connected equipment.
- H. Install expansion compensating devices for PEX tubing in accordance with the manufacturer's installation instructions.
- I. Coordinate with installation of piping seismic braces so they do not interfere with thermal expansion loop action or building joint loop action.

END OF SECTION 22 05 16

SECTION 22 05 29 - PLUMBING HANGERS AND SUPPORTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide a complete system of pipe hangers and supports for all plumbing and fire protection equipment and piping.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- B. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- C. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.

- B. Maintain this minimum temperature before, during, and for minimum three (3) days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Unistrut Corp.
 - 2. Erico Caddy.
 - 3. PHP System.
 - 4. Anvil/Anvil Strut.
 - 5. BLINE.
- B. Pipe Supports:
 - 1. Conform to MSS SP58.
 - 2. Hangers for Pipe sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Pipe sizes two (2) inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe sizes three (3) inches and Smaller: Cast iron hook.
 - 6. Wall Support for Pipe sizes four (4) inches and Larger: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - a. Provide at all system stub-ups from below grade thru ground floor slab.
 - 8. Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 9. Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 10. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 11. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
 - 12. Non-metallic pipe support: Vinyl-coated Hangers.
 - 13. PEX Tube Support: CTS sized hangers or supports free of sharp edges.
 - 14. Galvanized steel to be used for outdoor installation.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.
- B. Provide locking nuts on all rod extensions.
- C. Galvanized steel to be used for outdoor installation.

2.3 INSERTS

- A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 SLEEVES AND ESCUTCHEONS

- A. The Contractor shall furnish and set pipe sleeves and inserts for all work under this section and shall be responsible for their proper and permanent location. In the event that failure to do so requires cutting and patching, the remedial work shall be the responsibility of the Contractor.
- B. All pipes passing through floors, walls or partitions shall be provided with sleeves having an internal diameter 1-1/2" (3/4" annular space) larger than the outside diameter of the pipe or insulation on covered lines, except as otherwise specified herein.
- C. Sleeves for Pipes through Non-fire Rated Floors and Walls: 18 gage thick galvanized steel. Sleeves for all pipes through walls, beams and partitions shall finish flush with the finish line of the walls, beams and partitions.
- D. Sleeves for all piping shall extend 1/2" above finish floor, (except where under partitions, the sleeves shall be flush with the bottom of the partition) and after the installation of pipe shall be packed and made watertight with fire stopping sealant to maintain separations and fire ratings.
- E. Where pipes pass under footings and through exterior walls, sleeves shall be of galvanized steel pipe and shall be not less than 4" larger than the pipe being sleeved. Sleeves shall be made watertight where passing through waterproofed surfaces, exterior wall, and floor slabs on grade. Waterproofing shall be done by means of a steel slip on welding flange, continuously welded at the center of the sleeve and shall be painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2" of each face of the wall; (to within 2" of the top of sleeve at floors). The remaining space shall be packed and made watertight with a waterproof mastic. Mechanical expansion type rubber seals such as manufactured by Calpico Ind. and Thunderline Corporation are acceptable as alternate method of water proofing piping penetrations.
- F. Sleeves through floors or interior masonry walls shall be of galvanized steel pipe or wrought iron pipe size except where located in concealed pipe spaces where they may be of 22 gauge galvanized sheet steel if fire rating is maintained.
- G. Sleeves for piping to receive insulation shall be large enough to allow continuous insulation through sleeves.
- H. Spacing between or location of pipe sleeves in floor slabs, structural beams or structural walls shall be subject to the Structural Engineer's approval.
- I. Where pipes pass under load bearing footings they shall pass through a coated steel pipe sleeve as described above and extend past a 45 degree line out from the bottom of the load bearing structure. Concrete shall be used as backfill in the portions of trench within the 45 degree pressure line.
- J. Provide chrome plated escutcheon plates on pipes passing through walls, floors, and ceilings exposed to view. Escutcheons shall be of sufficient outside diameter to cover the sleeve opening and shall fit snugly around the insulated or bare pipe and to the wall, partition, floor or ceiling. Provide stainless steel sheet metal for exterior walls. Welded water ring sleeve shall be used on all exterior wall and floor penetrations.
- K. Sealant: Acrylic

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc., or approved equal.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Unistrut Corp., or approved equal.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.7 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp. Model.
 - 2. 3M fire Protection Products Model.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: Dark gray Black As selected from manufacturer's full range of colors.
- D. Plastic Tube and Pipe: Ensure that the appropriate firestop assembly is used for plastic piping systems. Refer to manufacturer's system selector for more information.

2.8 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.

4. Plywood or particle board.
 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
1. Furnish UL listed products or products tested by independent testing laboratory.
 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Do not drill or cut structural members.
- E. **Do not crush insulation with pipe clamp. Provide high density pipe insulation to accommodate pipe clamp or hanger.**
- F. **Do not attach beam clamp on to bottom of steel joist.**

3.2 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with MSS SP 58.

- B. Supports for Gas Piping:
1. Horizontal supports for steel and copper gas piping, threaded or welded, are every six (6) feet for 1/2 inch, every eight (8) feet for 3/4 inch and one (1) inch, and every ten (10) feet for 1-1/4 inches or larger.
 2. Vertical supports for steel gas piping, threaded or welded, are every six (6) feet for 1/2 inch, eight (8) feet for 3/4 inch and one (1) inch, and every floor for 1-1/4 inch and larger.
- C. Supports for Cast Iron Piping:
1. Vertical Piping:
 - a. Support vertical piping and tubing at base and at each floor.
 - b. Secure vertical piping at sufficiently close intervals to keep the pipe in alignment and to support the weight of the pipe and its contents. Support stacks at their bases and at sufficient floor intervals to meet the requirements of local codes. Approved metal clamps or hangers should be used for this purpose.
 - c. When vertical piping is to stand free of any support or if no structural element is available for support and stability during construction, secure the piping in its proper position by means of adequate stakes or braces fastened to the pipe.
 2. Horizontal Piping, Suspended:
 - a. Support horizontal piping and fittings at sufficiently close intervals to maintain alignment and prevent sagging or grade reversal. Support each length of pipe by an approved hanger located not more than 18 inches from the joint.
 - b. Support terminal ends of all horizontal runs or branches and each change of direction or alignment with an approved hanger.
 - c. Provide hangers as necessary to provide alignment and grade. Provide hangers at each horizontal branch connection. Adequate provision should be made to prevent shear. Where pipe and fittings are suspended in excess of eighteen inches by means of non-rigid hangers, a sway bracing to be provided.
 - d. An anchor or bracing to be provided on all storm drain pipe fittings.
 3. Place hangers within 12 inches of each horizontal elbow.
 4. Use hangers with 1-1/2 inch minimum vertical adjustment.
 5. Support horizontal cast iron pipe adjacent to each hub, with five (5) feet maximum spacing between hangers. Support hubless cast iron at every other joint unless over four (4) feet then support at each joint. Support copper every six (6) feet for 1-1/2 inch and smaller; every ten (10) feet for two (2) inches and larger.
 6. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
 7. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
 8. Support riser piping independently of connected horizontal piping.
- D. Supports for copper tubing:
1. The following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.

- e. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - f. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
 - g. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod
 2. Install supports for vertical copper tubing every 10 feet (3 m).
 3. Support vertical piping and tubing at base and at each floor.
- E. Supports for steel piping:
1. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical steel piping every 15 feet (4.5 m).
 3. Support vertical piping and tubing at base and at each floor.
- F. Supports for stainless-steel piping:
1. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - d. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - e. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - f. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - g. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - h. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical steel piping every 15 feet (4.5 m).
 3. Support vertical piping and tubing at base and at each floor.
- G. Supports for CPVC piping:
1. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.

- f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
 3. Support vertical piping and tubing at base and at each floor.
 - H. Supports for PEX tubing:
 1. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod. Or
 - b. 3/4" and smaller: 72 inches when a continuous support channel is used.
 - c. 1" and larger: 96 inches when a continuous support channel is used.
 2. Support vertical piping and tubing at base and at each floor.
 3. Install hangers for vertical PEX piping every 48 inches (1200 mm).
 4. Install PEX tubing in accordance with the Uponor Plumbing Design Assistance Manual or the Uponor Professional Plumbing Installation Guide.
 - I. Supports for PVC piping:
 1. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 2 (DN 50) and Smaller: 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - c. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - d. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - e. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical PVC piping every 48 inches (1200 mm).
 3. Support vertical piping and tubing at base and at each floor.
 - J. Supports for PP piping:
 1. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
 - a. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - b. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - d. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - e. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - f. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
 2. Install supports for vertical PP piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
 3. Support vertical piping and tubing at base and at each floor.
 4. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
 - K. Supports for insulated piping:

1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees. (Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers)
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
- L. Supports for Vertical-Piping
1. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - a. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 - b. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- M. Design hangers for pipe movement without disengagement of supported pipe.
- N. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- O. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries, **such as grade beam, basement wall, sump wall etc.:** Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

- D. Extend sleeves through floors one (1) inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation or caulk. Firestopping required at all penetrations of rated floor and walls.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.5 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating. Refer to Architectural drawings for location of all rated walls and floors.
- D. Fire Rated Surface:
 - 1. Seal opening at floor and wall as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- E. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of sealant or caulk suitable for application.
 - 2. Install escutcheons where pipe, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

END OF SECTION 22 05 29

SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 22.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the owner or owner's representative.

1.3 RELATED WORK

- A. Division 1 - GENERAL REQUIREMENTS.
- B. Section 01 09 00 - GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 00 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.4 SUMMARY

- A. This Section includes requirements for commissioning plumbing systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.5 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.6 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 22 is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 22, is required in cooperation with the Owner and the Commissioning Agent.

- B. The Plumbing systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.7 SUBMITTALS

- A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the OWNER prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.
- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of the Building Plumbing Systems will require inspection of individual elements of the Plumbing construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning Plan to schedule inspections as required to support the commissioning process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the OWNER and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 22 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected

Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.5 TRAINING OF OWNER PERSONNEL

- A. Training of the OWNER operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 22 Sections for additional Contractor training requirements.

END OF SECTION 22 08 00

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48 – VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
- F. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.3 SUMMARY

- A. Provide a complete domestic water piping system.
- B. Provide pressure gauge with all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, and leave in safe and proper operating condition all systems.
- C. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Gauge: Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and manufacturer instruction.
 - 4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.7 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size valve and two (2) loose keys for outside hydrants.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 WATER PIPING, BELOW GRADE

- A. Copper Tubing: ASTM B88, Type K.
 - 1. Fittings: ASME B16.22 wrought copper and bronze.
 - 2. Joints: AWS A5.8, BCuP silver braze.
- B. PEX-a Tubing: ASTM F876/F877, AWWA C904
 - 1. Fittings: ASTM F1960 engineered polymer and lead-free brass.
 - 2. Joints: ASTM F1960 cold expansion with PEX reinforcing ring.

2.3 WATER PIPING, ABOVE GRADE

- A. Copper Tubing 6" and smaller: ASTM B88, Type L hard drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints:
 - a. Solder, lead free, ASTM B32, 95-5TA (tin-antimony), or tin and silver, with melting range 430 to 535 degrees F. [Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.]
 - b. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - c. Appurtenances for Grooved-End Copper Tubing:
 - 1) Manufacturers: Subject to compliance with requirements, provide products from the following or approved equal:
 - a) Victaulic
 - 2) Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - 3) Mechanical Couplings for Grooved-End Copper Tubing:
 - a) Copper-tube dimensions and design similar to AWWA C606.
 - b) Ferrous housing sections.
 - c) EPDM-rubber gaskets suitable for hot and cold water.
 - d) Bolts and nuts.
 - e) Minimum Pressure Rating: 300 psig.

3. At the contractor's option, Press connection copper fittings manufactured by an approved manufacturer or approved equal will be acceptable. Building services piping –20 degrees to +250 degrees up to 200 PSI. Fittings shall comply with NSF-61, CSA, UPC. Seals shall be made of EPDM material and manufactured with an inboard bead design. The fittings shall include the Smart Connect feature to identify unpressed connections during system testing. All fittings shall be installed in accordance with the manufacturer's installation instructions and according to local plumbing and mechanical codes.
 - a. Approved manufacturer(s):
 - 1) Nibco
 - 2) Viega

- B. CPVC: Pipe and fittings shall be manufactured from virgin rigid CPVC (chlorinated polyvinyl chloride) vinyl compounds with a cell class per ASTM D 1784 and listed by ICC to ASTM E84, similar to SPEARS EVERTUFF CTS or approved equal.
 1. Pipe & Fittings = ASTM D 2846. All pipe and fittings shall be manufactured in the United States and shall conform to National Sanitation Foundation (NSF) Standards 14 and 61.
 2. Joints = ASTM F 493, solvent cements for CPVC pipe and fittings.
 3. Installations = Comply with the latest installation instructions published by manufacturer and shall conform to all applicable plumbing, fire and building code requirements. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized-vinyl products or other aggressive chemical agents not compatible with CPVC compounds.
 4. The system shall be hydrostatically tested after installation.

- C. Pipe 2" and smaller (NON-EXPOSED): PEX-a (Engel-Method Crosslinked Polyethylene) Piping: ASTM F 876 and F877 (CAN/CSA-B137.5) by Uponor and tested for compliance by an independent third party agency.
 1. Type: Wirsbo AQUAPEX. Standard grade hydrostatic design and pressure ratings from PPI. Fire-rated assembly listings in accordance with ANSI/UL 263.
 2. Fittings: elbows, adapters, couplings, plugs, tees and multi-port tees (1/2 inch through 3 inch nominal pipe size): ASTM F1960 cold-expansion fitting manufactured from the following material types:
 - a. UNS No. C69300 Lead-free (LF) Brass
 - b. UNS No. C27453 Lead-free (LF) Brass
 - c. 20% glass-filled polysulfone as specified in ASTM D 6394
 - d. Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D 6394
 - e. Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D 6394
 - f. Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D 6394
 - g. Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960"
 3. Accessories: Angle stops and straight stops that are compatible with PEX tubing are supplied by the PEX tubing manufacturer. Bend supports designed for maintaining tight radius bends are supplied by the PEX tubing manufacturer. ProPEX expander tool to install the ASTM F1960 compatible fittings are supplied by the PEX tubing manufacturer. The tubing manufacturer provides clips and/or PEX rails for supporting tubing runs. All horizontal tubing hangers and riser clamps are epoxy-coated material.
 4. X rails for supporting tubing runs. All horizontal tubing hangers and riser clamps are epoxy-coated material.

5. PEX-to-Metal Transition Fittings:
 - a. Manufacturers: Provide fittings from the same manufacturer of the piping.
 - b. PEX-a to Threaded Brass Transition: One-piece brass fitting with male or female threaded adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
 - c. PEX-a to Brass Sweat Transition: One-piece brass fitting with sweat adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
 - d. PEX-a to Flange Transition: Two-piece fitting with one steel flange conforming to ASME B 16.5 and one lead free (LF) brass adapter conforming to ASTM F 1960.
 - e. PEX-a to Groove Transition: One-piece lead free (LF) brass fitting with one CSA B242-05 groove end in either iron pipe size (IPS) or copper tube size (CTS) and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
 - f. PEX-a to Water Meter Transition: Two-piece fitting with one NPSM union thread and one ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
 - g. PEX-a to Copper Press Transition: One-piece lead free (LF) brass fitting with one ASME B16.51 copper press end and one ASTM F1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
 6. PEX-to-Thermoplastic Transition Fittings:
 - a. PEX-a to CPVC Transition: Thermoplastic fitting with one spigot or socket end and one ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
- D. PEX-a Tubing 3" : ASTM F876/F877
1. Fittings: ASTM F1960 engineered polymer and lead-free brass.
 2. Joints: ASTM F1960 cold expansion with PEX reinforcing ring.
 3. Basis of design Uponor AquaPEX pipe and ProPEX engineered polymer or lead-free brass fittings. All fittings shall be installed in accordance with the manufacturer's installation instructions and according to local plumbing and mechanical codes.

2.4 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size two (2) inches and Smaller:
 1. Ferrous pipe: Class 150 malleable iron threaded unions.
 2. Copper tube and pipe: Class 150 bronze unions with soldered joints.
- B. Pipe Size 2-1/2 inches and Larger:
 1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets (Victaulic split ring flange is not allowed).
 2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
 3. PEX-a tube and pipe: Class 150 ASME B16.5 flanges; ASTM F1960 joints.

2.5 GALVANIC PROTECTION

- A. Dissimilar piping material connections shall not be made without an approved dielectric union.
- B. Dielectric Connections:

1. Two (2) inches and smaller union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier. Provide Watts Series LF3001A or an approved equal.
2. 2-1/2 inches and larger, forged steel flanges, screwed neck, 1/16 inch thick preformed neoprene gasket.

2.6 VALVES

A. General

1. Valves shall be located to permit easy operation, replacement and repair. They shall be installed where shown on the Drawings, or as herein specified.
2. Control valves shall be provided for the domestic hot and cold water supply to all risers and specific areas such as restrooms, fixture groups, shock absorbers, equipment, hose bibbs and wall hydrants, food service areas and building separations. Valves shall be located in back-of-house or service areas with access panels or above lay-in ceilings. No access panels will be permitted in public spaces with gypsum ceilings.

B. Ball Valves:

1. Manufacturers:
 - a. NIBCO INC.
 - b. Milwaukee.
 - c. Apollo.
 - d. Bray.
 - e. Kitz.
 - f. Jomar
2. Two (2) inches and Smaller: Nibco S/T-585-80-LF, full-port, MSS SP 110, Class 150, 600 psi CWP, silicon bronze, or DZR Brass, two piece body, Stainless steel ball, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder or threaded ends. No Lead.
3. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive CPVC material that meets UL 2043 approved for inside air plenum. Also provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included.
4. Ball valves installed outdoors or in-ground shall have stainless steel handle.
5. Ball Valves for PEX-a Two (2) inches and smaller: NSF 359, Class 150, 250 psi CWP, forged brass, two piece body, brass ball, Teflon (PTFE) seats, blow-out proof stem, lever handle, ASTM F1960 ends. No Lead. Basis of design Uponor Lead-free Commercial Ball Valves.
6. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.
7. Provide memory stops on all ball valves installed in domestic hot water return lines. Memory stops shall be adjustable after pipe insulation is applied.

C. Shut-off Valves:

1. Manufacturers:
 - a. NIBCO INC.
 - b. Milwaukee.
 - c. Apollo.
 - d. Bray.
 - e. Kitz.

2. Line Shut-Off Valves 2-1/2" to 3" where system operating pressure will not exceed 300 p.s.i.g. shall be 300 WOG LEAD-FREE ductile iron body with non-rising stem, ductile iron wheel handle, bronze stem and flange ends. Acceptable valves are Nibco F-619-RWS, or approved equivalent model by Kitz, Bray, Milwaukee, or Apollo.
 3. Line Shut-Off Valves 4" and larger where system operating pressure will not exceed 300 p.s.i.g. shall be 300 CWP ductile iron body gate valve with non rising stem, resilient wedge, flange ends, EPDM liner and seal. Acceptable valves are NIBCO Model F-619-RWS/SON, or approved equal.
 4. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.
- D. Swing Check Valves:
1. Manufacturers:
 - a. NIBCO INC.
 - b. Milwaukee.
 - c. Apollo.
 - d. Kitz.
 2. Two (2) inches and Smaller: Nibco S-413-LF Series, class 125, MSS SP 80, silicon bronze body, stainless steel and PTFE disc, and soldered ends. No Lead.
 3. 2-1/2 inches and Larger: NIBCO INC. F918-SS Series, MSS SP 71, cast iron body, stainless steel fitted, stainless steel disc, flanged ends. No Lead.
- E. Balancing Valves (Hot Water Recirculation)
1. Balancing valves shall be venturi orifice type, bronze or brass body with brass or chrome ball, a minimum of two differential pressure read-out ports, 300 psi maximum working pressure. A compatible positive shutoff ball valve with memory stop is to be provided if not included with the balancing valve assembly.
 2. Balancing valves shall be Flow Design Incorporated (FDI) model AC or MC or approved equal by ITT or Bell and Gossett.
 3. Ball valves are not acceptable for balancing the hot water return system.

2.7 STRAINERS

- A. Manufacturer: NIBCO INC., Mueller Steam Specialty, or approved equal.
- B. Two (2) inches and Smaller: Threaded bronze body for 200 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen. NIBCO INC., 221 Series.
- C. 2-1/2 and Larger: Class 125, flanged iron body, Y pattern with 1/16-inch stainless steel perforated screen. NIBCO INC., F-721 Series.
- D. Lead Free.

2.8 GAGES AND TAPS

- A. Manufacturers: For portable water system (Lead Free)
 1. Weiss
 2. Marsh Bellofram
 3. Weksler
 4. Dwyer

- B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Stainless steel.
 - 2. Bourdon Tube: Phosphor bronze.
 - 3. Dial Size: 4-1/2 diameter.
 - 4. Mid-Scale Accuracy: One (1) percent.
 - 5. Scale: Psi.
- C. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.
- D. Ball Valve: Brass 1/4 inch NPT for 250 psi.
- E. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections.
- F. Siphon: Brass, 1/4 inch NPT angle or straight pattern.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than two (2) feet of cover.
- C. Establish minimum separation from other services piping in accordance with code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Install pipe on prepared bedding.
- F. Route pipe in straight line.
- G. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- H. Do not use lead bearing solder materials.
- I. Pipe Cover and Backfilling:
 - 1. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in four (4) inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
 - 2. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 3. Do not use wheeled or tracked vehicles for tamping.

- J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Insulate all piping installed in exterior walls, above food service areas, and any area exposed to temperatures below 40 degrees Fahrenheit.
- B. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Insulate all domestic hot water supply and return lines.
- D. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
- G. Provide expansion tank for each domestic water heater, install per manufacturer's recommendations.
- H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.
- I. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.
- J. Establish elevations of buried piping outside the building to obtain not less than one (1) foot of cover.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- L. Install water piping in accordance with ASME B31.9.
- M. Sleeve pipes passing through partitions, walls and floors.
- N. Install unions downstream of valves and at equipment or apparatus connections.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- Q. Install ball valves for shut-off and to isolate equipment at branch to each fixture bank and at each plumbing appliance or water heater.
- R. Provide check valves on discharge of all water circulating pumps.
- S. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler

systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.

- T. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
- U. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to all equipment with solenoid valves.
- V. Route all domestic water piping inside building in climate controlled space not subject to freezing.
- W. Do not use lead bearing solder materials.
- X. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 23 07 16 for specification on jacketing. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).
- Y. Provide chrome-plated floor and ceiling plates around pipes exposed to view when passing through walls, floors, partitions, or ceilings in finished areas. Size plates to fit pipe or insulation and lock in place.
- Z. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following.
- AA. Press-Connect Joints for Copper Tubing: Join copper tube and press-connect fittings with tools recommended by fitting manufacturer.
- BB. Pipe Joint Construction: PEX-a Connections: Install per manufacturer's recommendations. Use manufacturer-recommended cold-expansion tool for ASTM F 1960 connections.
- CC. Lead Free.

3.5 INSTALLATION - SERVICE CONNECTIONS

- A. At each incoming water service line provide approved reduced pressure back-flow preventer. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.
- B. Provide a cast iron sleeve around service main to six (6) inches above floor and six (6) inches minimum below grade beam. Size for minimum of two (2) inches of loose batt insulation stuffing.
- C. Optionally, where building structural components permit, water service entrance may be composed of a single extended 90 degree fitting of fabricated 304 stainless steel tubing, maximum Working pressure of 175 psi with grooved-end connection on the outlet (building) side and a cast iron pipe size coupler on the underground (inlet) side.

3.6 INSTALLATION - BACKFLOW PREVENTERS

- A. Provide at each make up connection to a hot water boiler, cooling tower, chilled water system, kitchen equipment, and at each piece of equipment requiring a make-up connection.

- B. Provide at water supply to fire protection system.
- C. Provide a floor drain within six (6) feet of each backflow preventer.
- D. Backflow preventer shall be certified by Contractor.
- E. Lead Free.

3.7 INSTALLATION – PRESSURE GAGES

- A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gage.
- B. Install gage taps in piping with isolation valves.
- C. Install pressure gages at main water entry. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install gage in piping to each inlet and outlet of water heater.
- E. Install gage in piping to each end of backflow preventer.
- F. Install gage in piping to each end of double check valves.
- G. Install gage in piping to each inlet and outlet of water softener.
- H. Install gage in piping to each inlet of water filter.
- I. Install gage in piping to each inlet of commercial dishwasher machine.

3.8 DOMESTIC HOT WATER SYSTEM BALANCING

- A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.
- B. Preparation of the hot water system for balancing:
 - 1. Confirm outlet temperature of the system at water heaters and/or storage tanks.
 - 2. Verify recirculation pump operation and rotation.
 - 3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.
- C. The test and balance report shall indicate the following:
 - 1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
 - 2. Pressure, temperature and flow in gpm at the suction side of each recirculating pump.
- D. Copies of the final approved balancing report are to be included in the O and M manuals as noted in “Permits” under Part 1 of Section 22 05 00.

3.9 FIELD QUALITY CONTROL

- A. Pressure test all domestic water piping.
- B. After installation and prior to backfill or cover-up, rinse piping system of particulate contaminants, cap and subject to static water pressure of 125 psig for four (4) hours.
- C. Repair leaks and defects and re-test any portion of piping system that fails.
- D. Provide written test report including date and time of test, pass or fail indication, summary of remedial work required and date and time of each re-test.
- E. Installers for PEX-a piping shall have completed the applicable training courses per manufacturer's requirements.
- F. Cleaning of piping systems:
 - 1. General cleaning of piping systems: Purge pipe of construction debris and contamination before placing the systems in service. Provide and install temporary connections as required to clean, purge, and circulate.
 - 2. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only.
 - 3. Phase One: Initial flushing of system.
 - a. Remove loose dirt, mill scale, weld beads, rust and other deleterious substance without damage to system components. Open valves, drains, vents and strainers at all system levels during flushing procedures. Flush until "potable water clear" and particles larger than 5 microns are removed.
 - b. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
 - 4. Phase Two: Cleaning of Piping Systems:
 - a. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), soldering flux, mill varnish, piping compounds, rust (iron oxide), and other deleterious substances not removed by initial flushing.
 - b. Flush system and replace with clean water.
 - 5. Phase Three: Final flushing and rinsing:
 - a. Flush and rinse until "potable water clear" and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.
 - 6. Submit status reports upon completion of each phase of work on each system.
- G. Branch Connections:
 - 1. Pipe 2" and smaller. For threaded piping, use straight size reducing tee. When branch is small than header, a nipple and reducing coupling or swagged nipple may be used.
- H. 2-1/2" through 36". For welding piping, when branch size is the same as header size, use welding tee. Use Weld-o-let when branch is smaller than header. For threaded branch connections, use 3000 lb. full coupling or Thread-o-let welded to header.
- I. See section 220500 for additional requirements.

LEAF Engineers
PBK Project No. 230462
Pkg 2 – Issue for Permit

WFAC Black Box Addition
Alamo Colleges District
July 19, 2024

END OF SECTION 22 11 16

SECTION 22 11 23 - DOMESTIC WATER PRESSURE BOOSTER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.
- C. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- D. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- E. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- F. SECTION 22 05 48 – VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
- G. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

- A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this section as if written in full herein.
- B. The scope of work described in these Specifications and/or indicated on the Drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all mechanical systems. All work shall be accomplished by workmen skilled in the various trades involved.
- C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Engineer shall be notified of the discrepancy.

1.3 STANDARDS

- A. The domestic water pressure booster system shall conform to all ordinances and regulations of the City, County, State and/or other authorities having jurisdiction in accordance with the requirements of the following codes, standards and design guides:
 - 1. The International Plumbing Code, 2018 Edition, with most current State of Texas Amendments

2. The International Building Code, 2018 Edition, with most current State of Texas Amendments
3. UL Listing - All motors, controllers and electrical components shall carry a UL Approval for the assembly.
4. NEMA Compliance - All controllers shall be designed in accordance with the specified NEMA requirements.
5. ANSI/NSF 61 compliance is required for all components of the domestic water system.

1.4 PERMITS

- A. The Contractor shall obtain all permits and inspections required for the installation of this work and pay all charges incident thereto. He shall deliver to the Architect all certificates of said inspection.

1.5 EQUIPMENT, MATERIAL BID BASIS

- A. Manufacturers' names, model numbers, etc. as specified on the Drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.
- B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in the Specifications or on the Drawings as "base" products. Proposed alternate equipment and materials may be submitted along with the "base" products, provided deductive pricing is included with the alternate.
- C. Alternate "approved equal" items listed shall conform to specified base items and shall be substantially equal in quality, size, weight, construction and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. The Engineer shall consider the use of the alternate equipment based on the supportive documentation and other information available to him, and shall approve or disapprove any alternates. The decision of the Engineer shall in all cases be final.
- D. The Contractor shall coordinate the installation of all equipment proposed for use in this project with all building trades (architectural, structural, and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval. Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost. When substitution of equipment is made, the Contractor shall be responsible for the costs of any item and engineering and construction revisions necessary in his or any other contract or trade that may be required to satisfy plans and specifications.

1.6 SUBMITTALS

- A. Shop drawings shall clearly indicate selection of model numbers, sizes, dimensions, electrical characteristics, etc. of the proposed equipment. Any deviations from specified equipment shall be clearly indicated on the submittal.

- B. Included with shop drawings of mechanical equipment requiring electrical connections shall be a written statement confirming coordination of voltage requirements, bearing the names and signatures of the mechanical and electrical contractors. A photocopied reproduction of the below statement is acceptable.
- C. Submittal shall include pump curves with selection point clearly identified and wiring diagrams for all electrical components.
- D. See additional requirements in section 22 05 00.

1.7 WARRANTY

- A. All equipment furnished and installed under this Contract shall be provided with the manufacturer's standard warranty unless otherwise noted.
- B. The Contractor shall make good all defects in material, equipment, or workmanship disclosed within a period of three (3) year from date of building acceptance by the Owner. The phrase "make good" shall mean to furnish promptly, without charge, all work necessary to remedy the defects to the satisfaction of the Engineer.

1.8 QUALITY ASSURANCE

- A. The Domestic water Booster system manufacturer shall have an extensive background and experience in the design and fabrication of Domestic Booster systems.
- B. The manufacturer shall have fabricated Domestic water Booster systems for a minimum of ten (10) years.
- C. The manufacturer shall provide single source responsibility for complete package. The entire package shall be third party certified by:
 - 1. Underwriters Laboratories Inc.
 - 2. The International Association of Plumbing and Mechanical Officials
 - 3. NSF 372 for compliance to Low Lead Content law
- D. Installer's Qualifications: The system shall be installed by a firm having minimum three years experience regularly engaged in the installation of variable speed domestic booster pump systems.
- E. Certification shall be obtained by the manufacturer indicating that the function and performance characteristics of all products and materials have been determined by testing and ongoing surveillance by an approved third-party certification agency. Assertion of certification shall be in the form of identification in accordance with the requirements of the third-party certification agency

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to the Project Site under provisions of Division 01 and Division 20.

- B. Protect internals from entry of foreign material by temporary caps on flanged openings.
- C. Store pumps in a dry location. Retain shipping flange, protective covers and protective coatings during storage. Protect bearings and couplings against damage from sand, grit and other foreign matter. Comply with manufacturers' rigging instructions for handling.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Pressure ratings of pumps, pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the anticipated system pressures in which they are installed.
- B. The Contractor shall ascertain for himself the space and access available for the installation of a factory assembled packaged unit and as an option may assemble the various components in place at the Site in lieu of providing a factory assembled unit. However, all components of the system shall be compatible and be furnished by a single source manufacturer and all electrical services and interconnecting equipment wiring must be provided for within this Contractors bid.
- C. The booster system shall be factory assembled on a steel skid including pumps, motors, valves, Type "L" copper or Schedule 40 300 series stainless steel suction and discharge manifolds, all interconnecting piping, wiring, variable frequency drives with logic and power controls.
- D. Over pressurization of the system while operating across-the-line shall be prevented by a pilot operated diaphragm type combination pressure regulating and non-slam check valve on each pump. Main valve and cover shall be ductile iron with a fused epoxy coating and stainless steel stem and cover bolts. Construction shall be suitable for the maximum working pressure of the system.
- E. All pilot lights and visual indicators shall be illuminated from the rear by long life LED lamps. Neon and incandescent lamps are not acceptable.
- F. Provide isolation valves on the suction and discharge of each pump. The isolation valves shall be 600 WOG full-port ball valves (2" and smaller) and lug style butterfly valves (2½" and larger).
- G. Provide two 4 1/2" ASME grade A, panel mounted gauges for indicating system suction and system discharge pressure.
- H. All skid-mounted components shall be factory finished in high quality epoxy or enamel paint. The base shall be suitable for grouting.
- I. The packaged pumping system shall include all electrical wiring between components and shall be completed and tested at the factory prior to shipment.
- J. Unions or flanges shall be provided for easy removal of pumps. Pipe headers shall be sized for a velocity not exceeding 7-1/2 FPS and shall be terminated with a groove joint capable of accepting a groove coupling or groove flange furnished by Contractor.

- K. System shall be arranged such that single point connections are required for piping and electrical power supply.
- L. Individual pumps, motors and pressure regulating or check valves shall be serviceable with the booster system in operation.
- M. All similar components shall be of one manufacturer, (i.e., valves, gauges, etc.).
- N. Refer to schedules on Contract Drawings for required pump capacities and electrical characteristics.

2.2 DOMESTIC WATER PRESSURE BOOSTER SYSTEM

- A. Furnish and install a factory fabricated vertical or horizontal mounted [simplex] [duplex] [triplex] [quadruplex] [quintuplet] pressure booster system. The system shall be capable of the capacity and flow rate as indicated on the Drawings.
- B. Pumps and Motor
 - 1. Pumps shall be variable speed horizontal or vertical multi-stage equipped with stainless steel shaft and impeller and sleeve mounted mechanical shaft seal.
 - 2. Each close-coupled pump motor shall be TEFC and of the energy efficient type and shall meet NEMA standards and operate within the available service factor at any point on the pump capacity head curve.
 - 3. Motors shall be high efficiency and balanced to a maximum vibration amplitude of .001". Motors shall have ball bearings and operate at 40° ambient. Each motor shall be equipped with the manufacturer's nameplate and shall have a sufficient horsepower rating to operate the pump at any point on the pump's head-capacity curve without overloading the nameplate horsepower rating of the motor, regardless of service factor. The motor shall have a service factor of 1.15 for variations in voltage and frequency.
 - 4. Each pump shall be provided with an individual temperature probe and purge valve having adjustable high temperature set point and differential to sense heat buildup in the pump casing. On sensing high temperature the probe circuit shall open a solenoid valve that allows the heated water to flow out.
 - 5. All pumps shall be provided with VFD drives.
- C. Variable Frequency Drives
 - 1. Provide and mount on the system skid [single] [two] [three] [four] [five] variable frequency drives of the PWM design suitable for variable torque applications using any standard NEMA Design B squirrel cage induction motor. Variable frequency drives shall sized for the maximum possible amp draw throughout the programmed sequence of pump operation.
 - 2. The efficiency at full load and full speed shall be 97% with a fundamental power factor of .98.
 - 3. Drives shall be pulse width modulated, start into a rotating load, follow signal from logic section of control panel when in auto mode and be provided with the following features:

- a. Hand/off/auto switch and manual speed adjustment.
 - b. Auto Drive Shutdown for electrical fault.
 - c. Automatic restart after power fails shutdown.
 - d. Provide complete service diagnostics with fault history log.
4. Keypad Operator Device including the following:
- a. 2 Line Backlit LCD Display.
 - b. Power On and Alarm/Fault Displays.
5. Operational data displays include:
- a. Drive Speed (HZ)
 - b. Motor Power
 - c. Energy (kWh)
 - d. Current
 - e. Elapsed Time
 - f. RPM
 - g. Motor Voltage
- D. Pump Sequencing
1. The pump designated as the lead pump shall start following a 5 second On-Delay time after sensing a drop in the system pressure 5 PSI below the desired set point value
 2. The pump controller shall compare a signal from the discharge pressure transducer to the set point value and the lead pump speed shall ramp up in order to satisfy the set point pressure.
 3. The lag pump shall start following a 60 second On-Delay time, when the lead pump exceeds its best operating point (BOP), and a minimum run timer shall ensure that the lag pump runs for a minimum of 60 seconds.
 4. The lag pump shall ramp down in speed and turn off when the pumps that are running are operating at a point below the BOP and the lag pump minimum run timer has expired.
 5. The lead pump shall continue to operate and meet system requirements based on the set point value.
 6. The lead pump shall alternate every 24 hrs of operation where the second pump shall start and run for a period of 5 seconds, both pumps shall operate, the first pump on shall ramp down and the new lead pump shall continue to operate as above to meet system requirements
- E. Lead pump shutdown controls
1. All systems are equipped with a 'No-Flow' shutdown that will stop the pumps when the pump controller determines there has been a 'No-Flow' condition for a continuous 5 minute period.
 2. The lead pump will start again once a drop in pressure of at least 5 psi is measured on the discharge of the system.
 3. The system can be manually operated by means of the virtual Hand-off-Auto (HOA) selector buttons provided on the operator interface
- F. Factory Fabrication

1. The system shall be factory fabricated complete with isolation valves on the suction and discharge of each pump. Suction and discharge manifolds are to be Type L copper or schedule 40 stainless steel. The pump assembly shall be provided with anti-vibration pads as specified below. The only field connections required will be to system headers, tank (if required), over temperature drain tube, and one incoming power connection at the control panel.
2. Provide stainless steel double sphere floating flange flexible vibration isolator complete with stainless steel control rod assemblies on the suction and discharge headers; Kinetics Kinflex FTC series or Engineer approved equal.
3. Provide base mount free-standing unhooded spring vibration isolators with 1/4" minimum neoprene noise isolation pads, Kinetics FDS series or Engineer approved equal.
4. Provide 6" minimum thickness inertia base frame for the mounting of the booster pump, Kinetics series CIB-L or Engineer approved equal.

G. Factory Test and Certification

1. The booster system and its component parts shall undergo a complete operating flow test from zero to 100% design flow rate under the specified suction and net system pressure conditions. The system shall carry an ETL certification of testing.

H. Start-Up-Service

1. The service of a factory-trained representative shall be provided on the jobsite for a minimum of one (1) day to provide the manufacturer's certification and start-up of the booster pump assembly. A formal report is to be issued indicating any revisions required for certification of the assembly by the manufacturer. Instruction and training of the operator's personnel shall be provided following certification of the assembly.

I. Acceptable manufacturers in compliance with the specified requirements:

1. Armstrong Pumps
2. Aurora Pumps
3. Grundfos BoosterpaQ
4. Syncroflo, Inc.
5. QuantumFlo

2.3 POWER AND CONTROL PANEL

- A. Assembly shall include a NEMA 12 power and control panel complete with three through the door disconnect switches, circuit breakers, magnetic starters each with 3 leg overload protection, fused control circuit transformer, automatic 24-hour alternation, low suction shutdown with visual alarm light and auxiliary contact, pump indicating lights, multiple position selector switches, control power light, low system indicating light, and lag pump start time delays. All of the above shall be factory internally pre-wired and tested in accordance with provisions of the National Electric Code. All control wires shall be individually numbered and each component shall be labeled accordingly. All internal wiring shall be copper stranded, A.W.G. with a minimum insulation of 90 degrees C. The complete assembly shall have the UL listing mark for industrial control panels.

- B. Instrumentation and Emergency Controls:
 - 1. Each system shall have panel mounted pressure gauges for indicating suction and system discharge pressure. A pre-wired and pre-piped temperature probe shall be installed in each pump and connected to a common electric purge valve for over temperature protection of pumps alarm horn with silence circuit, high system alarm with time delay, high suction shutdown with time delay, low level alarm light.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Provide pumps to operate at specified system fluid temperatures and scheduled capacities. Pumps shall operate without vapor binding and cavitations, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories. Provide no less than the minimum as required by the manufacturer.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping
- D. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment bases.
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct bases to withstand, without damage to equipment, seismic force required by code.
 - 3. Construct concrete bases 4 high and extend base not less than 6 inches in all directions beyond the maximum dimensions of base-mounted pumps unless otherwise indicated or unless required for seismic-anchor support.

4. Install base mounted pumps on concrete inertia base “RBMK” with spring isolators. Refer to section 22 05 00.
- E. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled, split coupled vertical in-line or base mounted pumps; install supports under elbows on pump suction and discharge line sizes four (4) inches and over.
- F. Provide air cock and drain connection on horizontal pump casings.
- G. Provide drains for bases and seals. Route to floor drain.
- H. Lubricate pumps before start-up according to manufacturer’s instructions.
- I. Install manual by-pass with shut-off valve where backflow prevention is provided

3.3 ALIGNMENT

- A. Alignment Service shall be performed by a factory authorized direct service technician. Alignment work shall not be performed by installing mechanical contractor.
- B. Comply with pump and coupling manufacturers' written instructions.

3.4 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Install triple-duty valve on discharge side of pumps.
- F. Install suction diffuser with stainless steel strainer and shutoff valve on suction side of pumps.
- G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves. Exception: do not install flexible connectors at or near split coupled vertical in-line pumps.
- H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

3.5 STARTUP SERVICE

- A. Start up service shall be performed by a factory authorized direct service technician. Start up work shall not be performed by installing mechanical contractor.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - a. Check piping connections for tightness.
 - b. Clean strainers on suction piping.
 - c. Perform the following startup checks for each pump before starting:
 - 1) Verify bearing lubrication.
 - 2) Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 - 3) Verify that pump is rotating in the correct direction.
 - d. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
 - e. Start motor.
 - f. Open discharge valve slowly.

3.6 DEMONSTRATION

- A. Demonstration shall be performed by a factory authorized direct service technician. Demonstration shall not be performed by installing mechanical contractor.
 - 1. Train owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.
 - 2. Provide documentation of owner training in close out submittal. See additional requirements in section 22 05 00.

END OF SECTION 22 11 23

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48 – VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
- F. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.3 SUMMARY

- A. Provide a complete sanitary drainage system.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of equipment and clean-outs.
- B. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include spare parts lists, exploded assembly views for pumps and equipment.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with the plumbing code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 SANITARY SEWER PIPING, BELOW GRADE

- A. PVC Pipe
 - 1. Provide a complete system of solid wall schedule 40 PVC DWV piping with solvent welded joints.
 - 2. Solvent welded joints shall conform to IAPMP installation standards IS-9.
 - 3. Provide tracer wire at all under slab piping and wire terminate at building exit. Wire to be 12AWG, green insulation, and copper conductor. Provide cast junction box flush with finished grade permanently labeled "Tracer Wire". Extend wire from exit point around all non-metallic piping to properly line, coordinate installation with Civil contractor.
 - 4. Pipe and fittings shall conform to ASTM D 1784, AST D 1785, ASTM D 2665, ASTM D 3311, and NPS standard 14 & 61.

2.3 SANITARY SEWER PIPING, ABOVE GRADE

- A. Manufacturers
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe/Soil Division
- B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
 - 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Ideal Tridon or Husky SD-4000.
 - 3. Transition coupling: No hub cast iron pipe to PVC use Husky SD 4200 transition coupling.

2.4 VENT PIPING, ABOVE GRADE

- A. Manufacturers
 - 1. AB&I
 - 2. Charlotte Pipe and Foundry Co.
 - 3. Tyler Pipe/Soil Division

- B. Cast Iron Pipe: ASTM A888 and CISPI 301, hub-less, service weight and marked with the collective trademark of the CISPI and listed by NSF International.
 - 1. Fittings: No hub cast iron fittings per CISPI 301 and ASTM A888.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies conforming to ASTM C564. Heavy duty couplings are required on no-hub systems at the base of stack and vertical to horizontal offsets and shall conform to the requirements of ASTM C1540 and shall be type 304 stainless steel shielded couplings with stainless steel worm gear clamps, 15 psi working pressure.
 - a. Acceptable Manufacturers: Ideal Tridon, Tyler Wide Body or Husky HD-2000.

2.5 VENT PIPING, BELOW GRADE

- A. Use same as Sanitary Sewer Piping, Below Grade.

PART 3 - EXECUTION

3.1 FLOOR DRAINS

- A. Provide floor drain, including sanitary waste and vent piping, where indicated on drawings and at each toilet room containing two (2) or more water closets or a combination of one (1) water closet and one (1) urinal.

- B. Coordinate the exact location of all floor drains with Architectural Drawings prior to rough-in. Ensure drains are located at low points(s) of floor slope.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

- B. Coordinate the exact location of all floor drains with architectural drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.

- C. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert as indicated on Drawings.

- B. Establish minimum separation from other services piping in accordance with code.

- C. Remove scale and dirt on inside of piping before assembly.

- D. Install with a uniform slope of not less than 1/4 of an inch per foot.

- E. Install pipe on prepared bedding of bank sand, minimum of 2" depth on bottom of trench up to centerline of pipe.
- F. Route pipe in straight line.
- G. Excavation:
 - 1. Excavate trenches for underground piping to the required depth to ensure two (2) foot minimum coverage over piping.
 - 2. Cut the bottom of the trench or excavation to uniform grade.
 - 3. Lay out alignment of pipe trenches to avoid obstructions. Assure that proposed route of pipe will not interfere with building foundation before any cutting is begun. Should interference be found, contact the Architect/Engineer before proceeding.
- H. Pipe Cover and Backfilling:
 - 1. Backfill shall not be placed until the work has been inspected, tested, and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable friable soils from other excavation as backfill material. Do not use peat, silt, muck, debris or other organic materials. Deposit backfill in uniform layers and compact each layer as specified in Division 2.
 - 2. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to optimum moisture content. Compact with power-driven tampers to the prescribed density. Place regular backfill in eight (8) inch maximum layers, loose measure. Compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
 - 3. PVC-piping shall be installed per the requirements of ASTM D 2321, which details the trench width per pipe size, bedding depth, backfill and compaction, as well as other factors. Calculating maximum burial depths for flexible piping requires the use of external loading software, additional information and free software is available at www.uni-bell.org.
 - 4. Restoration. Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks, and similar areas, to a condition equal to the adjacent undisturbed earth, and restore surface of the area to the condition existing prior to trenching or excavating operation.
- I. Disposal of excess material:
 - 1. Remove excess excavation material or material unsuitable for backfill. Excess material can be spread on grade, or shall be removed from site as directed by Owner/Architect.
- J. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one (1) percent) minimum. Maintain gradients.
- B. Provide and installed cleanout as required by code and local AHJ.
- C. Furnish and install cleanouts in soil and waste lines as required by Code and/or job conditions, as shown on the Drawings and as follows: At or near the end of each branch and main drainage line, horizontal lines at intervals as required by code. All cleanouts

shall be readily accessible, with plugs easily removable for cleanout lines. Cleanouts at the base of vertical piping shall be held within 2'-0" from finished floor unless otherwise indicated.

- D. Install a floor clean out according to the following;
 - 1. Not more than 40' apart in all horizontal drain lines.
 - 2. At each change of direction greater than 45 Deg.
 - 3. At the base of each waste or soil stack.
 - 4. Install floor cleanouts at elevation to accommodate finished floor.
 - 5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
 - 6. Provide Wye cleanouts with long sweeps turned up to elevated floor conditions for cleanout openings at floor drain waist lines.

- E. Install a wall cleanout according to the following:
 - 1. Install a wall cleanout at every sanitary piping within wet wall chase for all urinals. Wall cleanout shall be flush with exterior side of wall
 - 2. Provide full size wall cleanouts at end of run and on soil stack at ganged toilets where pipes penetrate the slab including water closets, lavatories and EDF's.
 - 3.

- F. Install a exterior cleanout according to the following:
 - 1. Encase exterior cleanouts in concrete flush with grade.
 - 2. Provide double cleanouts where building sanitary sewer system and civil sewage system intersect.
 - 3.

- G. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

- H. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

- I. Install piping to maintain headroom. Do not spread piping, conserve space.

- J. Group piping whenever practical at common elevations.

- K. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.

- M. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Architect.

- N. Install piping penetrating roofed areas to maintain integrity of roof assembly.

- O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

- P. Burred ends of all pipe and tubing shall be reamed to the bore of the pipe or tube and all chips shall be removed before installation.

- Q. Install bell and spigot pipe with bell end upstream.
- R. Sleeve pipes passing through partitions, walls and floors.
- S. Support cast iron drainage piping at every joint.
- T. Water test all piping per code.
- U. Insulate all above slab horizontal sanitary waste piping carrying air-conditioning condensate with fiberglass insulation with jacket from floor drain, including traps, all the way to change in direction to vertical.
- V. Slope all vent piping to allow for drainage.
- W. Provide and install a floor sink next to each HVAC air handling unit, pump, expansion tank, and every piece of HVAC equipment requiring condensate removal in every mechanical room.
- X. Drainage-waste-vent copper pipe and fittings for waste stub-outs for all fixture locations.
- Y. PVC-piping is a combustible material per ASTM E 136 and shall not be installed in return air plenums unless it is fire wrapped to meet all the requirements of ASTM E 84 test protocol with a flame spread index of 25 and a developed smoke spread of 50 or less.

3.5 RODDING SEWERS

- A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completions of the installation.
- B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned. Rodding operations shall be witnessed by Owner's field representative. Submit a certificate of completion to owner.

3.6 FIELD QUALITY CONTROL

- A. Separate trenches for water lines, sanitary, storm, and gas piping.
- B. Piping shall be labeled along entire length; indicating size, class, material specification, manufacturers name, and country of origin.
- C. Piping and fittings resting on ground is unacceptable. Keep products covered. Provide temporary end caps and closures on piping and fittings.
- D. Foreign pipe and fittings unacceptable.
- E. Prior to cover up water pipe, sanitary pipe, and gas piping shall be pressure tested. Tests shall be witnessed by consultant and owner. Notify owner 48 hours prior to test. Test shall be witnessed by client plumbing technician.
- F. The inside of all sanitary lines shall be video recorded with a camera and witnessed by owner to first outside manhole. Provide tape and/or DVD upon closeout of project. If any

obstructions are found they shall be removed and the line shall be videoed again to show the blockage has been cleared.

- G. For additions and renovations, use camera to locate routing of underslab lines.
- H. Upon completion of the sanitary piping system, the contractor shall notify engineer and owner to observe a smoke test of the system. Smoke testing shall be performed on sanitary piping system twice during construction.

END OF SECTION 22 13 16

SECTION 22 15 13 - COMPRESSED-AIR PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.3 SUMMARY

- A. This Section includes piping and related specialties for general-service compressed-air systems operating at 125 psig and less. Make connections to compressor, dryer, filter, and other related items of equipment and piping accessories, and extend air piping through building to all equipment, fixtures and outlets requiring same.

1.4 SUBMITTALS

- A. Product Data for the following:
 - 1. Pipes, tubes, and fittings.
 - 2. Flexible pipe connectors.
 - 3. Safety valves.
 - 4. Pressure regulators.
 - 5. Filters
 - 6. Automatic drain valves.
 - 7. Quick couplings.
 - 8. Hose assemblies.
- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.
- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.2 SYSTEM DESCRIPTION

- A. Shop air operating at 125 psig (1200 kPa).

2.3 PIPES, TUBES AND FITTINGS

- A. Schedule 40, Galvanized steel Pipe: ASTM A 53.
 - 1. Steel Nipples: ASTM A 733, made of ASTM A 53 or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
 - 2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded. Provide Class 300 and galvanized finish if indicated.
 - 3. Malleable-Iron Unions: ASME B16.39, Class 150, threaded.
 - 4. Wrought-Steel Fittings: ASME B16.9, Schedule 40, butt welding.
 - 5. Forged-Steel Fittings: ASME B16.11, socket type.
 - 6. Steel Flanges: ASME B16.5, Class 150, carbon steel.
 - 7. Press-Connect Fittings: MegaPressG ANSI LC-4/CSA 6.32.
- B. Flexible Pipe Connectors: Corrugated tubing with wire-braid covering.
 - 1. Manufacturers:
 - a. ANAMET Inc.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Hyspan Precision Products, Inc.
 - e. Mercer Rubber Co.
 - f. Metraflex, Inc.
 - g. Proco Products, Inc.
 - h. Unaflex, Inc.
 - 2. Stainless-Steel-Hose/Steel Pipe Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - a. Working-Pressure Rating: 200 minimum.
 - b. End Connections NPS 2 and Smaller: threaded Steel pipe nipple.

- c. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.4 UNIONS AND COUPLINGS

- A. Ferrous pipe: 150 psi malleable iron threaded connections.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.5 VALVES

- A. Ball Valves:
 - 1. 1/4 inch to one (1) inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port. Nibco T-585-70.
 - 2. 1-1/4 inch to 3 inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, conventional port. Nibco T-580-70.

2.6 SPECIALTIES

- A. Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
 - 1. Manufacturers:
 - a. Aeroquip Corporation.
 - b. Bowes Manufacturing, Inc.
 - c. Foster Manufacturing Co., Inc.
 - d. Milton Industries, Inc.
 - e. Parker Hannifin Corporation; Fluid Connectors Group; Quick Coupling Div.
 - f. Rectus Corp.
 - g. Schrader-Bridgeport; Amflo Div.
 - h. Schrader-Bridgeport/Standard Thomson.
 - i. Snap-Tite, Inc.
 - j. TOMCO Products Inc.
 - k. Tuthill Corporation; Hansen Coupling Div.
 - 2. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.
 - a. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
 - b. Plug End: Straight-through type with serrated outlet for attaching hose.
- B. Hose Assemblies: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.
 - 1. Hose: double-wire-braid, CR-covered hose for compressed-air service.
 - 2. Hose Clamps: Stainless-steel clamps or bands.
 - 3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with serrated ends for connecting two sections of hose.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the follow conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:
 - 1. Notify Owner not less than seven (7) days in advance of proposed interruption of compressed-air service.

3.2 PIPING APPLICATIONS

- A. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating use din applications below, unless otherwise indicated.
- B. Joining of Dissimilar Metal Piping: Use dielectric fittings.
 - 1. NPS 2 and Smaller: Dielectric unions.
 - 2. NPS 2-1/2 to NPS 4: Dielectric flanges.
 - 3. NPS 6 and Larger: Dielectric flange kits.
- C. Low-Pressure Compressed-Air Piping: Use the following piping materials for each size range:
 - 1. NPS 4 and Smaller: Schedule 40, black-steel pipe; threaded malleable-iron or press-connect fittings; and threaded or press-connected joints.
 - 2. NPS 6 to NPS 12: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.

3.3 PIPING INSTALLATION

- A. Install air and drain piping with 1 percent slope downward in direction of airflow.
- B. Install eccentric reducers where piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- C. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- D. Install flexible pipe connector on each connection to air compressors.
- E. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver.

3.4 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.
- B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.

- C. Install pressure regulators on compressed-air piping where reduced pressure is required.
- D. Install flexible pipe connectors in discharge piping [and in inlet air piping from remote air-inlet filter] of each air compressor.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to specialties and equipment to allow service and maintenance.
- C. Connect piping to air compressors, accessories, and specialties with shutoff valve and union or flanged connection.

3.6 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Test and adjust piping safety controls. Replace damaged and malfunctioning safety controls.
 - 2. Piping Leak Tests: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - 3. Repair leaks and retest until no leaks exist.
 - 4. Report results in writing.

END OF SECTION 22 15 13

SECTION 22 20 23 - GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48 – VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
- F. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

- A. Provide a complete natural gas piping system to all gas-burning appliances and all natural connectors.
- B. This section covers the complete first class natural gas system installation, within and to five (5) feet beyond building perimeter unless noted otherwise on Contract Drawings, including but not limited to piping, regulators, unions, valves, installation, testing and other normal parts that make the systems complete, operable, code compliant and acceptable to the authorities having jurisdiction.

1.3 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. 2015 Edition of the International Fuel Gas Code.
 - 2. Latest Edition of NFPA 54, National Fuel Gas Code.
 - 3. Minimum Safety Standards for Natural Gas, 49 Code of Federal Regulations (CFR) Part 192, as Required by Title 16 of the Texas Administration Code § 8.70.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
 - a. Strainers.
 - b. Natural gas pressure regulators.
 - c. Natural gas pressure relief valves.
 - d. Tape form pipe coating.
- B. Test Reports: Indicate results of piping system pressure test.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves, piping system, and system components.
- B. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.6 QUALITY ASSURANCE

- A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.
- B. Valves: Manufacturer's name, size, standards compliance and pressure rating clearly marked on outside of valve body.
- C. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- E. Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years documented experience. Installation of natural gas systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. All installation shall be supervised by a licensed Master Plumber. All testing shall be performed by a licensed Journeyman or Master Plumber. Welders shall be certified in accordance with ASME Section 9.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.9 EXTRA MATERIALS

- A. Furnish two packing kits for each type and size valve.

PART 2 - PRODUCTS

2.2 MANUFACTURERS

- A. Products and materials listed herein are for references of approved materials.
- B. Unless noted otherwise, the contract documents (schedule sheet) will specify the products and materials that are to be used for this project.

2.3 NATURAL GAS PIPING, BELOW GRADE

- A. Steel Pipe: ASTM A53 Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M forged steel welding type or ANSI LC-4/CSA 6.32 press-connect type (Viega MegaPressG, NIBCO BenchPressG).
 - 2. Joints: ASME B31.9, welded or ANSI LC-4/CSA 6.32, press-connect.
 - 3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
- B. Contractor Option: Provide Underground Gas Polyethylene (PE), SDR-11, ASTM D2513 pipe and fittings with heat fusion socket joints.
 - 1. Polyethylene pipe and fitting materials shall be compatible and by same manufacturer to ensure uniform melting and a proper bond. Fabricated fittings shall not be used.
 - 2. Provide connection between buried plastic gas service piping and metallic riser in accordance with the gas code. Provide metallic riser consisting of HDPE fused coating on steel pipe for connection to above ground building distribution piping. Underground horizontal metallic portion of riser shall be at least twenty four inches in length before connecting to the plastic service pipe. An approved transition fitting or adaptor meeting design pressure rating and plastic pipe manufacturers recommendations shall be used where the plastic joins the metallic riser.

2.4 NATURAL GAS PIPING, ABOVE GRADE (OUTDOOR)

- A. Piping 1½ inches and smaller shall be seamless Schedule 40 black steel, ASTM A106 or ASTM A53 Type "S", Grade A or B, with Class 150 black malleable iron threaded fittings conforming to ASME B16.3.

- B. Piping 2 inches and larger shall be Type "S" seamless or Type "E" electric resistance welded Schedule 40 black steel, ASTM A53, Grade A or B, with Schedule 40 wrought carbon steel fittings, ASTM A 234 and butt weld joints.
- C. Provide factory-applied, three-layer coating of epoxy, adhesive, and PE or field applied primer and epoxy paint coating on all pipe and fittings. Field applied coating is restricted to fittings and short sections of pipe necessarily stripped for threading or welding. Field coating shall be manufactured by Amercoat Type 240 or approved equal and applied in accordance with manufacturer's recommendations. Galvanizing shall not be considered adequate protection.

2.5 NATURAL GAS PIPING, ABOVE GRADE (INDOOR)

- A. Steel Pipe: ASTM A53 Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, ANSI LC-4/CSA 6.32 press-connect (Viega MegaPressG, NIBCO BenchPressG), or ASTM A234/A234M forged steel welding type.
 - 2. Joints: NFPA 54, threaded or press-connected through 2" max size or welded to ASME B31.9 above 2" size.
 - 3. EXCEPTIONS:
 - a. All exposed piping 1½ inches and smaller located within areas utilized as return air plenums shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.
 - b. All exposed piping 1½ inches and smaller serving laboratories from main natural gas riser to each emergency shut-off valve shall have welded joints with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.

2.6 UNIONS AND COUPLINGS

- A. Ferrous pipe: 150 psi malleable iron threaded connections.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.7 VALVES

- A. Manufacturers:
 - 1. Apollo.
 - 2. NIBCO.
 - 3. Milwaukee.
 - 4. Watts.
 - 5. Kitz.
 - 6. Homestead Valve.
- B. Ball Valves:
 - 1. 1/4 inch to 2-1/2 inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port. Nibco T-585-70-UL.
 - 2. 3 to 4 inch, MSS SP 110, 250 psi, two piece, threaded ends, brass body, stainless steel ball, reinforced teflon seats, blow-out proof stem, lever handle, UL listed for flammable liquids and LPG, Full port. Nibco T-FP-600A (CSA, UL, FM).

3. 3 inch and larger, MSS-SP-78, Type IV, Class 125, ASME/ANSI B16.38, 200 psi, lubricated plug valves with flanged or threaded ends. Bodies, plugs and bonnets shall be made from Gray Iron castings, ASTM A-126, Class B. Homestead Valve series 600 (CSA, UL, FM).

2.8 STRAINERS

- A. Manufacturers:
 1. O.C. Keckley Company or approved equal.
- B. Two (2) inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- C. 2-1/2 inch to four (4) inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- D. Five (5) inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.9 NATURAL GAS PRESSURE REGULATORS

- A. Manufacturers:
 1. BelGas.
 2. Itron.
 3. Honeywell.
 4. Sensus.
 5. Maxitrol.
 6. Fisher.
- B. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.
 1. Temperatures: minus 20 degrees Fahrenheit to 150 degrees Fahrenheit.
 2. Body: Steel.
 3. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.
 4. Disk, diaphragm, and O-ring: Nitrile.
 5. Maximum inlet pressure: 150 psig
 6. Furnish sizes two (2) inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.

2.10 NATURAL GAS PRESSURE RELIEF VALVES

- A. Manufacturers:
 1. Fisher 289H, or approved equal.

- B. Product Description: Spring loaded type relief valve.
 - 1. Body: Aluminum.
 - 2. Diaphragm: Nitrile.
 - 3. Orifice: Brass.
 - 4. Maximum operating temperature: 150 degrees Fahrenheit.
 - 5. Inlet Connections: Threaded.
 - 6. Outlet or Vent Connection: Same size as inlet connection.

2.11 UNDERGROUND PIPE MARKERS

- A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum six (6) inches wide by four (4) mil thick, manufactured for direct burial service.

2.12 PROTECTIVE COATING

- A. Underground steel service entry piping shall be furnished with factory applied plastic coating and field coating at joints conforming to AWWA Standard C-203. All valves, fittings, and joints in underground piping shall be field coated using a heat-applied coal tar enamel tape, using two coats of heavy mastic, using "Scotchwrap," "CT Tapecoat" or "X-Tru-Tape." Field coating shall extend over mill wrapping a minimum of 4 inches. Damaged coating shall be repaired as specified for valves, fittings, and joints.

2.13 EMERGENCY SHUT-OFF VALVE

- A. Kitchen.
 - 1. The main gas supply to kitchen equipment shall be provided with an automatic solenoid valve with manual reset lever. The valve shall be interconnected with the hood fire suppression system to shut down gas supply to all kitchen equipment.
 - 2. The valve shall be energized to open, closed when de-energized with manual reset. The required voltage shall be coordinated with the electrical contractor. The valve shall carry a UL Listing.
 - 3. The emergency shutoff valve is to be provided with manual shutoff valves and unions on each side and located in a surface mount steel cabinet with flush solid metal door. The cabinet is to be located as shown on the drawings with the top of cabinet flush with finished ceiling. The cabinet shall be Potter Roemer 1000 series or approved equal.
 - 4. The emergency shutoff valve is to be provided with manual shutoff valves and unions on each side and located in a surface mount steel cabinet with flush solid metal door. The cabinet is to be located as shown on the drawings with the top of cabinet flush with finished ceiling. The cabinet shall be Potter Roemer 1000 series or approved equal.
 - 5. Valves 3/4"-2-1/2" in size shall be ASCO 8044 series.
- B. Laboratory Classrooms – See related section 22 30 00.
- C. Provide Emergency Earthquake Gas Shut Off Valves.

2.14 LABORATORY NATURAL GAS PIPING

- A. All natural gas piping serving labs from main natural gas riser shall be routed exposed to view below ceiling and painted in accordance with Division 09. (Delete this if is not required on school project).
- B. Install emergency gas shut-off valve in each line serving individual laboratory rooms. Locate (Emergency) shut-off actuator within lab area adjacent to each room exit at 54 inches above finished floor. Location of emergency shut-off shall be accessible to occupants for shutting off the natural gas supply under emergency conditions and comply with Texas Accessibility Standards Accessible Elements and Space requirements.
- C. The emergency shutoff valve is to be provided with manual shutoff valves and unions on each side and located in a surface mount steel cabinet with flush solid metal door. The cabinet is to be located as shown on the drawings with the top of cabinet flush with finished ceiling. The cabinet shall be BLC Lab Controls or approved equal.
- D. Gas piping joints shall be welded from main natural gas riser to each emergency shut-off valve. Piping from the emergency shutoff valve to the outlets shall be assembled with threaded fittings provided all joints are exposed to view or within the confines of laboratory furniture.
- E. Install flexible stainless steel appliance/equipment connector at each fume hood and biological safety cabinet requiring natural gas service. Connectors shall not be concealed within or extended through wall, floor or partition and shall be located entirely in the same room as the connected equipment. Provide an accessible shut-off valve not less than the nominal size of the equipment connector, immediately ahead of the connector.

PART 3 - EXECUTION

3.2 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.3 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Install plastic ribbon tape continuous over top of pipe buried six (6) inches below finish grade, above pipe line.

3.4 INSTALLATION - BURIED PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Establish minimum separation of gas pipe from other services, piping in accordance with code.
- C. Install continuous jacket or tape.
- D. Install gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure regulators. Gas service distribution piping to

have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

- E. Install Work in accordance with Gas Company standards.
- F. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 psi for 24 hours.
- G. Provide pipe sleeve as required for gas pipe routing under slab or in conceal space.
- H. Provide tracer wire for all piping routed below slab locate wire leads in accessible location for use in future line trouble shooting.

3.5 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Provide rigid appliance connections for each gas-burning appliance in accordance with code.
- C. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- D. Provide an accessible, approved shut-off valve within three (3) feet of each gas appliance. Install such that appliance can be maintained and removed without removal of the shutoff valve.
- E. Install gas pressure regulator vent full size opening on regulator and terminate outdoors.
- F. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.
- G. Install service pipe and set gas meters in accordance with Gas Company regulations. Coordinate with division 23 to install gas flow meter provided by division 23 and install by this contractor.
- H. Gas piping installed in plenums and chases shall be welded.
- I. In natatorium, including equipment rooms, all exposed plumbing piping shall be insulated and protected by a complete aluminum jacketing system. Refer to Section 15083 for specification on jacketing. Provide color coded, printed pipe label 10' on center identifying pipe service type (gas, domestic water, storm water, etc.).
- J. Provide shut-off valves on both sides of all gas regulators for isolation of gas regulators.
- K. Provide a manual shut off valve on the appliance gas supply line in addition to the Kitchen Ansul unit automatic shut off.
- L. Provide a gas valve manifold to isolate kitchen gas appliances individually at one location.
- M. Provide separate gas valves on each fixture in labs.
- N. Provide a gas isolation valve on the lab controller unit.

- O. Install a test port of each side of all natural gas pressure regulators.
- P. Perform a pressure test of all replaced natural gas piping.
- Q. Gas piping on roof shall be supported at appropriate intervals to prevent sagging. Spacing shall be determined by the roof type and loading. No piping shall rest directly on the roof.
- R. All supports shall be manufactured for the purpose of supporting pipe. Wood blocks are not an acceptable means of pipe support.

3.6 FIELD QUALITY CONTROL

- A. Pressure test natural gas piping in accordance with NFPA 54. Pressure test prior to backfill, minimum 50 psi for 24 hours.
- B. Defective joints or piping shall be replaced as required and the system shall then be re-tested.

END OF SECTION 22 20 23

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48 – VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
- F. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

- A. Provide a complete installation for each equipment type listed in this section.
- B. Section Includes:
 - 1. COMMERCIAL ELECTRIC WATER HEATERS
 - 2. VACUUM RELIEF VALVES
 - 3. IN-LINE CIRCULATORS
 - 4. T & P RELIEF VALVES
 - 5. DIAPHRAGM-TYPE EXPANSION TANKS
 - 6. ELEVATOR SUMP PUMP (ESP-1) - Standard
 - 7. AIR COMPRESSOR
 - 8. OVERHEAD AIR HOSE REEL (HR-1)
 - 9. ACID DILUTION BASIN
 - 10. ACID DILUTION TRAP
 - 11. BACKFLOW PREVENTERS
 - 12. WATER PRESSURE REGULATING VALVES
 - 13. WATER HAMMER ARRESTORS
 - 14. THERMOSTATIC MIXING VALVES
 - 15. SOLENOID VALVES
 - 16. SCALE PREVENTION SYSTEM (PS-1)
 - 17. INLINE WATER SERVICE FILTER
 - 18. FLOW METER
 - 19. TEMPERATURE INSTRUMENTS

1.3 SUBMITTALS

- A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power

requirements. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Submit electrical characteristics and connection locations.

- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept all equipment on site in original labeled cartons. Inspect for damage.
- B. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.5 EXTRA MATERIALS

- A. Furnish two pump seals.

PART 2 - PRODUCTS

2.1 COMMERCIAL ELECTRIC WATER HEATERS (EWH-x)

- A. Manufacturers:
 - 1. A.O. Smith.
 - 2. Bradford White.
 - 3. American Water Heater.
 - 4. Rudd.
 - 5. State.
 - 6. Rheem.
 - 7. All electric point-of-use storage tank type water heaters provided within this project shall be the product of one manufacturer.
- B. Furnish and install a Factory-assembled and wired, electric, vertical storage domestic hot water heaters with dimensions, capacities and electrical characteristics as scheduled on the Contract Drawings and as outlined herein. This Specification describes minimum quality and performance requirements. Variations of system components by the individual referenced manufacturers are acceptable for installation in this project provided they meet or exceed all of the requirements indicated herein, are compatible with the electrical service provided and fit properly in the allocated space.
- C. Water heater(s) shall have the UL seal of certification and be factory equipped with an ASME rated temperature and pressure relief valve. Water heater(s) shall be constructed in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section IV Part HLW. Tank(s) shall have a coating of high temperature porcelain enamel and furnished with two (2) magnesium anode rods rigidly supported. Water heater(s) shall meet or exceed the standby loss requirements of ASHRAE. Tank(s) shall have a working pressure of 160 psi and shall be completely assembled.
- D. Tank: Shall be insulated with 2-1/2" of rigid polyurethane foam insulation or with minimum two (2) inches glass fiber polyurethane encased in corrosion-resistant steel jacket; baked-on enamel finish.

- E. Controls: Equip with diagnostic panel utilizing light emitting diodes. Each LED will correspond to the number and location of the heating elements and monitor their on-off function. Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees Fahrenheit, flanged or screw-in nichrome elements, high temperature limit thermostat. Water heater(s) shall be provided with internal power circuit fusing, control circuit fusing, magnetic contactors, 120-volt control circuit transformer and immersion thermostat(s) with manual reset high limit control.
- F. Water heater(s) shall capable for remote monitoring, Controls, leak detection and fault alert.
- G. The heater(s) shall meet or exceed current standard or ASHRAE/IESNA 90.1 for recovery efficiency and standby loss. The tank shall have a 5-year warranty against failure as outlined in the written warranty. Professional start-up service shall be included.
- H. Capacity:
 - 1. Storage capacity: 10 gal or as indicated.
 - 2. Heating element size: 3 kW or as indicated.
 - 3. Number of heating elements: 1 or as indicated.
 - 4. Minimum recovery rate: (as indicated) gph with 100 degrees Fahrenheit temperature rise.
 - 5. Maximum working pressure: 160 psig.
 - 6. Provide integral heat traps.
 - 7. Provide drain pan.
- I. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.

2.7 VACUUM RELIEF VALVES

- A. Construction shall be bronze body with silicone disc having a dry guide which is located out of the water. Unit shall open at less than 1/2" vacuum and be suitable for use within a system having a maximum water pressure of 200 psi and a maximum temperature of 250°F. Vacuum relief valves shall be in compliance with the appropriate requirements of ANSI Z21.22.
- B. Vacuum relief valves shall be manufactured by Watts Regulator, Wilkins or Conbraco.

2.8 IN-LINE CIRCULATORS

- A. Manufacturers:
 - 1. Bell and Gossett
 - 2. Taco
 - 3. Aurora
 - 4. Armstrong
 - 5. Grundfos
- B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 80 psig, 150 psig maximum working pressure.
- C. Casing: Cast iron, with flanged pump connections.
- D. Impeller: Cast bronze, dynamically balanced and keyed on shaft.
- E. Bearings: Two, oil lubricated bronze sleeve, integral thrust collar.

- F. Seal: Carbon rotating against stationary ceramic seat, 212 degrees Fahrenheit maximum continuous operating temperature.
- G. Drive: Flexible coupling.
- H. CP-1, 1/6 HP or as scheduled and fitted with remote heat sensing aqua-stat and timer.
- I. Aqua-stat: Honeywell – Model L4006A1009 (100 – 240 degree range) or approved equal by Johnson Controls and Dayton.
- J. Timer: Armstrong – Model 810233-130 or approved equal by Taco, Bell and Gossett, Grundfos, or Armstrong

2.9 T & P RELIEF VALVES

- A. Manufacturers: Watts Industries or approved equal.
- B. Temperature and Pressure Relief:
 - 1. ANSI Z21.22 certified, bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees Fahrenheit, capacity ASME Section IV certified and labeled.
- C. Vacuum Relief Valves:
 - 1. Watts N36 Lead Free Series.

2.10 DIAPHRAGM-TYPE EXPANSION TANKS

- A. Manufacturers: Bell & Gosset PT Series or approved equal.
- B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 12 psig.
- D. Provide separate support to structure for expansion tank

2.16 SCALE PREVENTION SYSTEM (PS-1)

- A. A Watts OneFlow scale prevention system shall be installed on the main water service pipe just after it enters the building, but after other whole building water safety devices (backflow preventers or pressure reducing valves), to effectively address water hardness concerns. A system may also be installed further downstream to protect specific equipment or areas within a plumbing system. The system shall be plumbed with a bypass valve to allow isolation of tank(s) and to allow the bypass of untreated water in the event that service or media replacement be necessary. The installation area should be suitable in size for the tank(s) to be serviced without encumbrance and sit upright on a flat level surface. The system must operate in an upflow manner and not require additional water to backwash, flush, or regenerate once put into service. The system must be installed in parallel with CPVC manifold to meet peak flow rate requirements.
- B. Capacities:
 - 1. pH = 6.5 to 8.5
 - 2. Hardness (max.) = 75 grains
 - 3. Water Pressure = 15psi to 100psi

4. Temperature = 40F to 110F
5. Watts OneFlow Model OF1465-50

2.21 ELEVATOR SUMP PUMP (ESP-1) - Standard

- A. General: Submersible type, complete with manual switch and magnetic starter.
- B. Pump; Cast iron, bronze fitted, with stainless steel shaft. Oil-less sleeve guide bearings, semi-open impeller, expansion joints at discharge column.
- C. Motor: Constructed to operate continuously without overheating while submerged, built-in automatic reset thermal protection, cord length as required.
- D. High Water Alarm: Provide high water alarm assembly consisting of Mercoid #41 alarm switch in basin and 24-volt transformer with six (6) inch bell, auxiliary alarm contacts, and silence button in a NEMA II panel located as indicated on drawings. Provide engraved lamacoid plate on panel face lettered.
- E. Characteristics: Sump Pump
- | | |
|--------------------|-----------------|
| GPM | 50 |
| Head in Feet | 20 |
| Minimum Horsepower | 1/2 |
| Maximum RPM | 1750 |
| Voltage / Phase | Ref: Electrical |
| Manufacturer | Aurora |
- F. Manufacturer: Aurora as indicated or comparable model by Gould, Stancor, Pacific, Hydromatic Paco.

2.25 AIR COMPRESSOR

- A. (AC-1): Champion Model No. VR5-12 (5HP/460/3/60) with vertical 120-gallon receiver with R-15B compressor capable of delivering 17CFM @ 175 PSIG. Unit to be furnished with Model No. CGD-25A1 air dryer (115/1/60) with a flow capacity of 25 CFM. Coordinate with Electrical for electrical requirements. Provide unit with all motor control components including starter.
- B. Accessories:
1. Inlet-Air Filter: Combination inlet-air filter-silencer, suitable for remote installation, for each air compressor.
 - a. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.
 - b. Capacity: Match capacity of air compressor, with filter having collection efficiency of 99 percent retention of particles larger than 10 micrometers.
 2. Flexible Connectors:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - (1) Flex-Hose Co., Inc.
 - (2) Flexicraft Industries.
 - (3) Hyspan Precision Products, Inc.
 - (4) Mercer Rubber Co.
 - (5) Metraflex, Inc.

- (6) Proco Products, Inc.
- (7) Unaflex, Inc.
- (8) efacqc
- b. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - (1) Working-Pressure Rating: [**200 psig**] [**250 psig**] minimum.
 - (2) End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
 - (3) End Connections, NPS 2-1/2 and Larger: Flanged steel nipple
- 3. Filters: (10 scum – 170 SCFM)
 - a. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration and drain cock. [**Include mounting bracket if wall mounting is indicated.**]
 - b. Coalescing Filters/Regulator: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. [**Include mounting bracket if wall mounting is indicated.**]

2.26 OVERHEAD AIR HOSE REEL (HR-1)

- A. Overhead air hose reel with 50' 1/2" air hose. Model: Balcrank 2111-036..

2.27 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventers
 - 1. Comply with ASSE 1013.
 - 2. Bronze body, with bronze internal parts and stainless-steel springs.
 - 3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
 - 4. Manufacturers:
 - a. Febco 825Y.
 - b. Hersey FRP II
 - c. Wilkins 975.
 - d. Watts Series LF909, or approved equal
- B. Double Check Valve Assemblies:
 - 1. Comply with ASSE 1012.
 - 2. Bronze body with corrosion resistant internal parts and stainless-steel springs; two independently operating check valves with intermediate atmospheric vent.
 - 3. Dual Check Valve with Atmospheric Vent shall be installed at referenced cross-connections. Valve shall feature stainless steel and rubber internals protected by an integral strainer. Primary check shall be rubber to rubber seated, backed by the secondary check with rubber to metal seating.
 - 4. Manufacturers:
 - a. Febco 815.
 - b. Hersey BCP
 - c. Wilkins 760.
 - d. Watts Series 9D or approved equal.
- C. Dual Check Valves:

1. Comply with ANSI/NSF Standard 18, Manual Food and Beverage Dispensing Equipment. (ASSE 1022 Approved Dual Check Valve).
2. Body and adapters are of 316 stainless steel construction and all rubber components comply with FDA food additive regulations.
3. All materials in contact with the potable water are in compliance with the requirements of the Safe Drinking Water Act, Public Law 93-523, National Interim Primary Drinking Water Regulations.
4. Manufacturers:
 - a. Wilkins 740.
 - b. Watts Model SD-2/9BD, or approved equal

D. Lead Free

2.28 WATER PRESSURE REGULATING VALVES

- A. Low to Moderate Flow Systems (Less Than 70 GPM) and Individual Equipment
1. Sizes 1/2" through 2"
 2. All bronze body
 3. 0.25% maximum weighted average lead content
 4. Integral stainless-steel strainer screen
 5. Built-in bypass check valve
 6. FDA approved elastomers
 7. Renewable seat
 8. Union end connection
 9. Rated for water temperature up to 180°F and minimum 300 psi inlet pressure. Provide model with inlet pressure rating, reduced pressure range and factory preset outlet pressure as scheduled on Contract Drawings.
 10. Manufactured by Wilkins Series 600XL or approved equal by Watts
- B. Large Demand Systems
1. Sizes 1-1/4" through 2 - ASTM B62 bronze body
 2. Sizes 2-1/2" and larger - ASTM A536 ductile iron body
 3. Pressure reducing pilot control
 4. Stainless steel disc guide, seat and bearing cover
 5. Stainless steel stem, nut and spring
 6. FDA approved Nylon reinforced Buna-N rubber diaphragm
 7. Provide model(s) with size, temperature range, inlet pressure rating, reduced pressure range, outlet pressure and options as scheduled on Contract Drawings.
 8. Cla-Val Company Series 90 or approved equal by Watts

2.29 WATER HAMMER ARRESTORS

- A. Manufacturers: Watts Series LF15M2 Series or approved equal.
- B. ANSI A112.26.1; copper construction, piston type sized in accordance with PDI WH-201.
- C. Pre-charged suitable for operation in temperature range 33 to 180 degrees Fahrenheit and maximum 150 psi working pressure.
- D. Access Panel: Acorn Model 8292 or approved equal.
- E. Lead Free.

2.30 THERMOSTATIC MIXING VALVES:

- A. Manufacturers:
 - 1. Leonard.
 - 2. Acorn controls.
 - 3. Power.
 - 4. Bradley.
 - 5. Zurn/Wilkins.

- B. Certified to ASSE Standard 1017, ASSE 1070, and meets the anti-scald requirements of ASSE Standard 1016.

- C. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.

- D. Capacity:
 - 1. TMV-1: Flow capacity between 0.35 gpm Min. and 4 gpm Max. at 5 psi pressure drop. Lead Free.
 - a. Model:
 - (1) Lawler 1070 Series
 - (2) Leonard – 170-LF
 - (3) Acorn controls - ST70CP-38
 - (4) Power - LFLM495
 - (5) Zurn/Wilkins – ZW3870XLT-4P

- E. Accessories:
 - 1. Check valve on inlets.
 - 2. Volume control shut-off valve on outlet.
 - 3. Stem thermometer on outlet.
 - 4. Strainer stop checks on inlets.

- F. Cabinet: 16 gage stainless steel, for recessed mounting with keyed lock.

- G. Mechanical Rooms: Omit cabinet, surface mount.

- H. Mount:
 - 1. TMV-1 in piping under lavatory/sink/etc.

- I. Lead Free.

2.31 FLOW METER

- A. Water meter
 - 1. Provide clamp-on ultrasonic water flow meter at the main water point of entry or as indicated on plan.
 - 2. Provide Onicon F-4300 meter with the followings.
 - a. Accuracy +/- 1.0% of reading from 1.6 ft/s to 20 ft/s
 - b. Repeatability +/- 0.25 % of reading
 - c. Bi-directional flow range of 1.6 to 40 ft/s
 - d. Process pipe-wall temperature: 32°F to 140°F
 - e. Power supply: 120VAC , 60 Hz, 10 VA max. .(provide transformer as needed)
 - f. Output signals:
 - (1) 4-20 mA DC current output
 - (2) Pulse (configurable)
 - (3) Relay (configurable)
 - g. Digital communications: RS-232, RS-485, Modbus RTU

- h. Materials:
 - (1) Enclosure NEMA 4X
 - (2) Transducers IP68 (Encapsulated)
 - i. Standard cable length: 25 ft (9 m), Maximum cable length: 100 ft (30 m)
 - 3. Acceptable Manufacturers:
 - a. Sierra
 - b. Siemens
 - c. Dynasonics
 - d. Onicon
- B. Natural/Propane gas meter
- 1. Provide insert mass flow meter at the main water point of entry or as indicated on plan.
 - 2. Provide Onicon F-5500 meter with the followings.
 - a. Accuracy +/- 0.5% of reading from 0.16 ft/s to 20 ft/s
 - b. Repeatability +/- 0.25 % of reading
 - c. Bi-directional flow range of 0.16 to 40 ft/s
 - d. Process pipe-wall temperature: 32°F to140°F
 - e. Input power: 12-28 VDC, 6 W min.
 - f. Power supply: 120VAC , 60 Hz, 10 VA max.(provide transformer as needed)
 - g. Output signals:
 - (1) 4-20 mA DC current output
 - (2) Pulse (configurable)
 - (3) Relay (configurable)
 - h. Digital communications: RS-232, RS-485, Modbus RTU
 - i. Materials:
 - (1) Enclosure NEMA 4X
 - (2) Transducers IP68 (Encapsulated)
 - j. Standard cable length: 15 ft (9 m), Maximum cable length: 100 ft (30 m)
 - 3. Acceptable Manufacturers:
 - a. Sierra
 - b. Thermal Instrument Co.
 - c. Dynasonics
 - d. Onicon
- C. Blowdown meter
- 1. Provide 2" stainless steel water flow meter with pulse output at the cooling tower blow down line or as indicated on plan.
 - 2. Provide PRM # WM200SSVX meter with the followings.
 - a. Accuracy +/- 5.0% of transitional flow and +/- 2.0% normal flow
 - b. Process pipe-wall temperature: 32°F to104°F
 - c. Flow range: 2-100 GPM.
 - d. Output signals:
 - (1) Pulse (configurable)
 - e. Materials:
 - (1) 304 Stainless steel
 - (2) Seal: Viton
 - f. Standard cable length: 10 ft (9 m), Maximum cable length
 - 3. Acceptable Manufacturers:
 - a. Stenner
 - b. EKM
 - c. Carlon Meter
 - d. PRM

- D. Warranty
 - 1. Products are warranted to be free from defects in material and workmanship and will be repaired or replaced at no charge to the owner, provided return or rejection of product is made within a reasonable period but no longer than one (1) year for calibration and non-calibration defects, from date of delivery

2.32 TEMPERATURE INSTRUMENTS

- A. Manufacturer: Trerice, Taylor, Marsh, Weksler, Marshalltown, Weiss, or Miljoco.
- B. Thermometer Wells.
 - 1. Brass or type 300 stainless steel. Machined bar stock, 1-piece construction.
 - 2. Where installed in insulated piping or vessels, provide with extension neck to match insulation thickness.
 - 3. Provide metal-to-metal contact with bulb chamber for maximum sensitivity.
 - 4. Wells shall be sized to extend a minimum of 50% into pipe

2.33 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Coordinate required voltage, wire size and over current device size with electrical drawings. Contractor shall provide all electrical connections per manufacturer's installation instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment on concrete housekeeping pad, minimum 4 inches high and six (6) inches larger than water heater base on each side. Refer to Section 03 30 00
- B. Install water heater with the followings.
 - 1. Maintain manufacturer's recommended clearances around and over water heaters.
 - 2. Connect natural gas piping in accordance with NFPA 54.
 - 3. Provide water heater pan beneath all water heaters with 3/4-inch drain to nearest floor sink.
 - 4. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.
 - 5. Install the following piping accessories.
 - a. On supply:
 - (1) Thermometer well and thermometer.
 - (2) Strainer.
 - (3) Pressure gage.
 - (4) Shutoff valve.

- (5) Diaphragm-type expansion tank
 - b. On return:
 - (1) Thermometer well and thermometer.
 - (2) Pressure gage.
 - (3) Shutoff valve.
 6. Install the following piping accessories on natural gas piping connections.
 - a. Strainer.
 - b. Pressure gage.
 - c. Shutoff valve.
 - d. Pressure reducing valve.
 7. Install discharge piping from relief valves and drain valves to nearest floor drain.
 8. Install circulator and diaphragm expansion tank on water heater.
 9. Install water heater trim and accessories furnished loose for field mounting.
 10. Install electrical devices furnished loose for field mounting.
 11. Install control wiring between water heater control panel and field mounted control devices.
 12. On gas-fired equipment connect flue to water heater outlet, full size of outlet.
 13. Provide factory start-up and demonstration, including operating instructions for all gas-fired water heaters. Schedule training sessions with Architect and Owner's representative. Provide certification letter from manufacturer indicating water heater is installed in accordance with manufacturer's instructions.
- C. Circulating Pump Installation: Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
1. Install the following piping accessories.
 - a. On supply:
 - (1) Pressure gage.
 - (2) Shutoff valve.
 - (3) Check valve.
 - b. On return:
 - (1) Thermometer well and thermometer.

- (2) Timer.
- (3) Pressure gage.
- (4) Shutoff valve.

D. Water softener: Install system components according to manufacturer's published recommendations and pipe as indicated on Drawings. Care shall be exercised in fabricating plumbing lines to avoid all cross connections eliminate the possibility of water contamination.

1. Provide and install double check valve assembly backflow prevention on the potable water line serving the water softener downstream of all potable water connections serving any other outlets or equipment.
2. Backflow preventers shall be duplexed where located within lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (twenty-four hour) water service is required.
3. Provide a physical air gap of at least two times the diameter of the softener equipment drain piping discharging into a floor drain/sink receptor.
4. Provide for the service of a competent supervising agent from the water softener manufacturer to inspect the completed installation, start the water softening system in operation and acquaint the operators with the proper operation and maintenance of the equipment.

E. Backflow Preventers and Vacuum Breakers.

1. Isolate all non-potable water requirements from the building domestic water system with backflow prevention device manufactured and certified for the particular application.
2. Pipe relief from backflow preventer indirectly to drain of sufficient size to evacuate maximum flow discharge.
3. Backflow preventers shall be duplexed full-size where located within domestic water lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (24 hour) water service is required.
4. Test ports shall not be located more than 72 inches above finished floor or permanent platform.
5. Do not install vacuum breakers or backflow preventers above equipment, above ceilings, concealed within walls, or areas where water leakage can cause damage.
6. Install a strainer immediately upstream of each vacuum breaker and backflow preventer.

F. Water Hammer Arrestors (Hydraulic Shock Absorbers).

1. Provide hydraulic shock absorbers in cold and hot water supply lines to each fixture branch, battery of fixtures and at each automatic, solenoid-operated or quick-closing valve serving equipment.

2. Locate and size hydraulic shock absorbers in accordance with PDI-WH-201 Standard and manufacturer's published recommendations.
 3. Install hydraulic shock absorbers with clearances to allow inspection, removal and replacement. Provide access panels where required.
- G. Water Pressure Regulating Valves.
1. Provide isolation valve, strainer and pressure gauge immediately upstream of each pressure regulating valve.
 2. Provide pressure gauge and isolation valve immediately downstream of each pressure regulating valve.
 3. Installation shall allow sufficient access to and space around components for adjustments and servicing.
 4. Provide services of a direct factory representative for start-up service, inspection and necessary adjustments for all large demand regulators
- H. Grease traps shall be cleaned and pumped prior to substantial completion. Interior joints shall be properly sealed.
- I. Install diaphragm-type expansion tank on cold water supply line.
- J. Install flow meter on cold water supply line and gas line at point of entry. Coordinate with div. 23 (BAS) for signal output and div. 26 for power requirements.
- K. Sewer and Sump pump Discharge Piping:
1. Factory or field fabricated, galvanized, ASTM A53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class125, cast-iron flange and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings.
 2. Underground piping shall be Copper Tubing: ASTM B88, Type K. Fittings: ASME B16.22 wrought copper and bronze. Joints: AWS A5.8, BCuP silver braze.

END OF SECTION 22 30 00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. SECTION 22 05 00 – COMMON WORK RESULT FOR PLUMBING
- C. SECTION 22 05 16 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
- D. SECTION 22 05 29 – PLUMBING PIPE HANGERS AND SUPPORTS
- E. SECTION 22 05 48 – VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
- F. SECTION 22 05 48.13 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

1.2 SUMMARY

- A. Provide a complete system of plumbing fixtures and trim.
- B. All materials and equipment for the potable water system shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.

1.3 SUBMITTALS

- A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.5 EXTRA MATERIALS

- A. Furnish two sets of faucet washers flush valve service kits lavatory supply fittings shower heads toilet seats.

PART 2 - PRODUCTS

2.1 FLUSH VALVE WATER CLOSETS

- A. Fixture Manufacturers:
1. American Standard.
 2. Kohler Co.
 3. Zurn.
- B. Fixture Trim Manufacturers:
1. Bemis
 2. Beneke
 3. Church
 4. Delaney
 5. Sloan Valve Co.
 6. Zurn Industries.
 7. American Standard.
- C. WC-1: ASME A112.19.2M; wall hung, siphon jet vitreous china closet bowl, with elongated rim, 1-1/2 inch top back spud, china bolt caps. Provide as indicated on plumbing fixture schedule.
1. Wall Mounted: American Standard 3351.101.020
 2. Or as indicated on schedules.
 3. Trim : (Type x)
- D. WC-2: Same as WC-1, except mounted at ADA/TAS height for appropriate age group.
1. Wall Mounted: American Standard 3351.101.020
 2. Or as indicated on schedules.
 3. Trim : (Type x)
 4. Provide flush valve stem offset as required.
- E. Trim:
1. Sensor Operated Flush Valve (Type A): ASME A112.18.1; exposed chrome plate, diaphragm type with battery operated solenoid operator, infrared sensor and over-ride button in plate chrome cover, 2" offset flush connection, vandal resistant stop cap and vacuum breaker maximum 1.28 gallon. Sloan Model 8111-1.28 or provide as indicated on plumbing fixture schedule.
 2. Sensor Operated Flush Valve (Type B): ASME A112.18.1; exposed chrome plated, diaphragm type with 24V transformer, solenoid operator, infrared sensor and manual over-ride button in chrome plated cover, 2" offset flush connection, integral screwdriver stop with vandal resistant stop and vacuum breaker, maximum 1.28 gallon flush volume. Sloan 111 ESS Hardwired-1.28 DFB-TMO-HW or provide as indicated on plumbing fixture schedule.

3. Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, seat bumper, 2" offset flush connection, integral screwdriver stop and vacuum breaker; maximum 1.28 gallon. Sloan Model Royal or Zurn AV Series or Sloan 111-1.28 (standard), Sloan 115-1.28 DFB (ADA) or provide as indicated on plumbing fixture schedule
- F. Seat: White/Black plastic, open front, extended back, self-sustaining hinge, stainless steel mounting hardware, brass bolts, with without cover. Manufacturer: Bemis, Beneke, Olsonite, and Church. Bemis 1655SSCT or provide as indicated on plumbing fixture schedule.
- G. Wall Mounted Carrier: ASME A112.6.1; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers. Jay R. Smith 200 series carriers, or equal by zurn and watts.

2.2 WALL HUNG URINALS

- A. Fixture Manufacturers:
 1. American Standard Plumbing.
 2. Kohler Co.
 3. Zurn.
- B. Fixture Trim Manufacturers:
 1. Delaney
 2. Sloan.
 3. Zurn.
 4. American Standard.
- C. All urinal flush valves shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- D. U-1: ASME A112.19.2M; vitreous china, wall hung, elongated rim integral trap, removable stainless steel strainer, 3/4 inch top spud, provide chair carrier as required. American Standard Pintbrook Model 6002.001 or provide as indicated on plumbing fixture schedule.
 1. Trim : (Type x)
- E. U-2: Same as U-1, except mounted at ADA/TAS height for appropriate age group.
 1. Trim : (Type x)
- F. Trim:
 1. Sensor Operated Flush Valve (Type A): ASME A112.18.1; exposed chrome plate, diaphragm type with battery operated solenoid operator, infrared sensor and over-ride button in plate chrome cover, vandal resistant stop cap and vacuum breaker maximum 1 pint. Sloan Model G2 OPTIMA PLUS 8186-0.5 Series or provide as indicated on plumbing fixture schedule.

2. Sensor Operated Flush Valve (Type B): ASME A112.18.1; exposed chrome plated, diaphragm type with 24V transformer, solenoid operator, infrared sensor and manual over-ride button in chrome plated cover, integral screwdriver stop with vandal resistant stop and vacuum breaker, maximum one (1) pint flush volume. Sloan Model 186 ES-S or provide as indicated on plumbing fixture schedule.
 3. Exposed Flush Valve (Type C): ASME A112.18.1; exposed chrome plated, diaphragm type with non-hold open handle, escutcheon, integral screwdriver stop with vandal resistant stop cap, vacuum breaker; maximum one (1) pint flush volume. Sloan Model Royal, or Zurn AV series. Sloan Flushometer 186-0.125 DBP or provide as indicated on plumbing fixture schedule.
- G. Wall Mounted Carrier: ASME A112.6.1; cast iron and steel frame with rectangular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs. Provide bottom bearing plate. Jay R. Smith figure 0637, or equal by Zurn and watts or provide as indicated on plumbing fixture schedule.

2.3 LAVATORIES

- A. Fixture Manufacturers:
1. American Standard Plumbing.
 2. Kohler Co
 3. Zurn.
- B. Fixture Trim Manufacturers:
1. Sloan
 2. T & S Brass.
 3. Chicago.
 4. Speakman.
- C. Supply Fittings Manufacturers:
1. Chicago.
 2. McGuire.
 3. Brasscraft.
 4. Zurn.
- D. All lavatory faucets and trim shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- E. L-1, Under-counter Lavatory: ASME A112.19.2M; vitreous china, unglazed rim for under counter mount with rear overflow, 19-1/4" x 14-1/4" inches with drillings on eight (8) inch centers. **American Standard 0496.221** or provide as indicated on plumbing fixture schedule.
1. **Trim : (Type x)**

F. Trims:

1. Supply Fitting: ASME A112.18.1 (Type A1); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with maximum 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago 802-VE2805-665ABCP.
2. Supply Fitting: ASME A112.18.1 (Type B); chrome plated brass spout, supply fitting with open grid strainer, water economy aerator with maximum 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Mechanical Faucet 420-E2805ABCP or provide as indicated on plumbing fixture schedule.
3. Supply Fitting: ASME A112.18.1 (Type C1); chrome plated brass spout, supply fitting with open grid strainer, battery operated sensor faucet with water economy aerator with maximum 0.5 gpm flow, ADA compliant. Sloan Model EBF-650 or provide as indicated on plumbing fixture schedule.
4. Supply Fitting: ASME A112.18.1 (Type C2); chrome plated brass spout, supply fitting with open grid strainer, battery operated sensor faucet with water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucets Model EQ-C12A-12ABCP or provide as indicated on plumbing fixture schedule.
5. Supply Fitting: ASME A112.18.1 (Type C3); chrome plated brass spout, supply fitting with open grid strainer, battery operated sensor faucet with water economy aerator with maximum 0.5 gpm flow, ADA compliant. Chicago Faucet 116.606.AB.1 Series or provide as indicated on plumbing fixture schedule.
6. Supply Fitting: ASME A112.18.1 (Type C4); chrome plated brass spout, supply fitting with open grid strainer, 24V transformer sensor faucet with water economy aerator with maximum 0.5 gpm flow, ADA compliant. Chicago Faucet 116.706.AB.1 Series or provide as indicated on plumbing fixture schedule.
7. Supply Fitting: ASME A112.18.1 (Type D1) ; chrome plated brass spout, supply fitting with open grid strainer, 24V transformer sensor faucet with water economy aerator with maximum 0.5 gpm flow, ADA compliant. Sloan Model ETF-600-8-B-BDM or provide as indicated on plumbing fixture schedule.
8. Supply Fitting: ASME A112.18.1 (Type D2); chrome plated brass spout, supply fitting with open grid strainer, 24V transformer sensor faucet with water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucets Model EQ-A-12A-52ABCP or provide as indicated on plumbing schedule.
9. Supply Fitting: ASME A112.18.1 (Type D3); chrome plated brass spout, supply fitting with open grid strainer, 24V transformer sensor faucet with water economy aerator with maximum 0.5 gpm flow, single supply for temperature Chicago Faucets EQ-A13A-51ABCP and or provide as indicated on plumbing fixture schedule.
10. Supply Fitting: ASME A112.18.1 (Type D4); chrome plated brass spout, supply fitting with open grid strainer, 24V transformer sensor faucet with water economy aerator with maximum .5 gpm flow, dual supply for temperature Chicago Faucets EQ-A13A-52ABBN ADA compliant or provide as indicated on plumbing fixture schedule.

11. Supply Fitting: ASME A112.18.1 (Type E1); chrome plated brass spout, quantum compression operating cartridge, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucet 895-317E2805-5ABCP.
12. Supply Fitting: ASME A112.18.1 (Type E2); chrome plated brass spout, quantum compression operating cartridge, supply fitting with open grid strainer, water economy aerator with 1.0 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucet 895-317E65VRGD1AB.
13. Supply Fitting: ASME A112.18.1 (Type E3); chrome plated brass spout, quantum compression operating cartridge, supply fitting with open grid strainer, water economy aerator with 1.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucet 895-317E35ABCP.
14. Supply Fitting: ASME A112.18.1 (Type E4); chrome plated brass spout, quantum compression operating cartridge, supply fitting with open grid strainer, water economy aerator with 2.2 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucet 895-317E29ABCP.
15. Supply Fitting: ASME A112.18.1 (Type F1); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucets Model 807-E2805-665PSHAB or provide as indicated on plumbing fixture schedule.
16. Supply Fitting: ASME A112.18.1 (Type F2); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucets Model 857-E2805-665PSHAB or provide as indicated on plumbing fixture schedule
17. Supply Fitting: ASME A112.18.1 (Type H); chrome plated brass spout, metering valve cartridge, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet Co. Series, or equivalent by T&S Brass, and American Standard. Chicago Faucets Model 333-E2805-665PSHAB or provide as indicated on plumbing fixture schedule.
18. Supply Fitting: ASME A112.18.1 (Type I); chrome plated brass spout, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, ADA compliant. Chicago Faucet 3510-E2805AB Series, or equivalent by T&S Brass, and or provide as indicated on plumbing fixture schedule.
19. Supply Fitting: ASME A112.18.1 (Type J1); chrome plated brass spout, supply fitting with open grid strainer, water economy aerator with 0.5 gpm flow, 4 inch wrist blade handle. ADA compliant. Chicago Faucet 201-G8AE2805F317AB, or equivalent by T&S Brass, or provide as indicated on plumbing fixture schedule.

G. Accessories:

1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
 2. Chrome plated 17 gage open grid P. O. plug.
 3. Removable key stops.
 4. Flexible supplies.
 5. Trap and waste insulated and offset to meet ADA compliance.
 6. Tempering valve – Power LFe480 series, Acorn, or Leonard.
- H. Floor Mounted Carrier: ASME A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, concealed arm supports, bearing plate and studs. Jay R. Smith 710 Series, or equal by Zurn and watts.

2.4 SINKS

- A. Fixture Manufacturers:
1. Elkay Mfg.
 2. Just
 3. American standard
 4. Advance Tabco
- B. Fixture Trim Manufacturers:
1. Chicago Faucet Co.
 2. T & S Brass
 3. Symmons
 4. Speakman
- C. Supply Fittings Manufacturers:
1. Chicago.
 2. McGuire.
 3. Brasscraft.
 4. Zurn.
- D. All sink faucets and trim shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- E. SK-1: Single Compartment Bowl: ASME A112.19.3; 19-1/2 x 19-1/2" x 6-1/2 inch outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Elkay Model LRADQ191965PD or provide as indicated on plumbing fixture schedule.

1. Trim: ASME A112.18.1 (Type J1): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 0.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE2805-F-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
 2. Trim: ASME A112.18.1 (Type J2): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.0 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-G8AE26-F-317AB, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
 3. Trim: ASME A112.18.1 (Type J3): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE35-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
 4. Trim: ASME A112.18.1 (Type K1); chrome plated brass supply with rigid spout, vandal proof water economy aerator with maximum 1.5 gpm flow, four (4) inch wrist blade handles and quarter turn ceramic disc cartridges. Chicago Faucet Model 1100-L9E35-317ABCP, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.
- F. SK-2: Double Compartment Bowl: ASME A112.19.3; 33 x 19-1/2 x 6-1/2 inch outside dimensions 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drains 3-1/2 inch crumb cups and tailpieces, ledge back drilled for trim. Elkay Model LRADQ331965PD or provide as indicated on plumbing fixture schedule.
1. Trim: ASME A112.18.1 (Type J1): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 0.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE2805-F-317CP, or equivalent by T&S Brass and American Standard.
 2. Trim: ASME A112.18.1 (Type J2): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.0 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE26-F-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
 3. Trim: ASME A112.18.1 (Type J3): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE35-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
 4. Trim: ASME A112.18.1 (Type K1); chrome plated brass supply with rigid spout, vandal proof water economy aerator with maximum 1.5 gpm flow, four (4) inch wrist blade handles and quarter turn ceramic disc cartridges. Chicago Faucet Model 1100-L9E35-317ABCP, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.

- G. SK-3: Single Compartment Bowl: ASME A112.19.3; 25" x 21-1/4" x 6-1/2" outside dimensions, 18 gage thick, Type 304 stainless steel. Self-rimming and undercoated, with 1-1/2 inch chromed brass stainless steel drain, ledge back drilled for trim. Elkay Model LRADQ252165PD or provide as indicated on plumbing fixture schedule.
1. Trim: ASME A112.18.1 (Type J1): chrome plated brass supply with rigid spout, vandal proof water economy aerator with 0.5 gpm flow, 8" fixed center, 4" vandal proof Wrist blade Chicago Faucet Model 201-G8AE2805F317AB, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.
 2. Trim: ASME A112.18.1 (Type J2): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.0 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE26-F-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
 3. Trim: ASME A112.18.1 (Type J3): chrome plated brass supply with rigid spout, 4" vandal proof wrist blade, water economy aerator with 1.5 gpm. Mechanical faucet deck mounted 8" fixed Center, dual supply for hot and cold water service Chicago Faucets Model 201-AGN8AE35-317CP, or equivalent by T&S Brass and American Standard or provide as indicated on plumbing fixture schedule.
 4. Trim: ASME A112.18.1 (Type K1); chrome plated brass supply with rigid spout, vandal proof water economy aerator with maximum 1.5 gpm flow, four (4) inch wrist blade handles and quarter turn ceramic disc cartridges. Chicago Faucet Model 1100-L9E35-317ABCP, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.
- H. SK-4: Single Compartment Bowl: ASME A112.19.3; 16-3/4" x 15-1/2" x 6" outside dimensions, 20 gauge, Type 304 stainless steel with a buffed satin finish, center drain. Elkay Model CHS1716C or provide as indicated on plumbing fixture schedule.
1. Trim: (Type L1) ASME A112.18.1; 8" centerset wall mount faucet with 4" Gooseneck Spout 2" Lever handles 1/2" offset inlets. Vandal resistant aerator standard with 1.5 gpm, chromo plate brass with quarter turn ceramic disc valve and requires 2 faucet. Elkay Faucet Model LK940GN04L2H, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.
 2. Trim: (Type L2) ASME A112.18.1; 8" centerset wall mount faucet with 8" arch tube spout 2" lever handles 2" inlet chrome. Vandal resistant aerator standard with 1.5 gpm, chromo plate brass with quarter turn ceramic disc valve and requires 2 faucet. Elkay Faucet Model LK945AT08L2T, or equivalent by T&S Brass and or provide as indicated on plumbing fixture schedule.
- I. Accessories:
1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
 2. Chrome plated 17 gage brass basket strainer.
 3. Removable key stops.
 4. Flexible supplies.
 5. Trap and waste insulated and offset to meet ADA compliance.

- J. Provide offset waste on all sinks.

2.5 LAVATORY and SINK INSULATION & SHIELD KIT

- A. Manufacturers:
 - 1. Truebro/IPS
 - 2. Plumberex
 - 3. Zurn
- B. Product Description: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.
- C. Provide Lavatory shield: Rigid enclosure is dimensionally engineered to comply with ADA requirements, design aesthetics and mechanical cooperation. LAV SHIELD conceals electronic faucet components, mixing valves, trap primers and instantaneous water heaters*, eliminating vandalism while allowing wheelchair accessibility under lavatories. Available in the standard model for field fit applications or may be ordered as a factory pre-cut which closely follows the underside contours of the lavatory specified.
 - 1. UL listing in accordance with ADA Standards.
 - 2. Flammability - UL-94 V-0, 5VA ASTM D-635-91 4 (ATB) 2.1 (AEB).

2.6 SHOWERS (Regular) – (SH-1)

- A. Manufacturers:
 - 1. Chicago Faucet Co.
 - 2. Acorn Engineering Company.
 - 3. Speakman.
 - 4. Leonard Valve Co.
 - 5. Symmons
 - 6. Powers
- B. SH-1: ASME A112.18.1; concealed shower supply with pressure balanced or thermostatic mixing valves, integral service stops, chrome plated vandal-proof institutional head with integral wall mounting flange, built-in 1.5 gpm flow, and escutcheon. Acorn – SV16-LVR – 519 - MSH - F1.5 or provide as indicated on plumbing fixture schedule.

2.7 SHOWERS (ADA) – (SH-2)

- A. Manufacturers:
 - 1. Acorn Engineering Company.
 - 2. Powers.
 - 3. Approved equal.

- B. SH-2 ADA: ASME A112.18.1 and ASSE 1016-2011; concealed shower supply with pressure balanced and thermostatic mixing valves, integral service stops, hand held shower () with 69 inch metal clad hose and 24 inch glide mounted on right hand side (), flow rate 1.5 GPM. ACORN – SV16-LVR – HHC15 - HSSH - HHSE - IVB – SB – PK or provide as indicated on plumbing fixture schedule.
- C. Accessories (select applicable per the plans):
1. Top Supply with:
 - a. T11: Drain Base with Dome Grate
 - b. T15: Drain Base with Center Vent, Drain Grate
 - c. T21: Drain Base with Center Vent
 - d. T25: Drain Base with Center Vent
 2. Bottom Supply with:
 - a. B11: Drain Base with Dome Grate
 - b. B15: Drain Base with Center Vent, Drain Grate
 - c. B21: Drain Base with Center Vent
 - d. B25: Drain Base with Center Vent
 3. Showerhead type: (6'-0" or 5'-6")
 - a. S15 - Standard Showerhead (Flow Rate = 1.5 GPM/5.7 LPM)
 - b. SX15 - Severe Service Showerhead (Flow Rate = 1.5 GPM/5.7 LPM)
 - c. SF - Deluxe Showerhead w/ Ball Joint (Flow Rate = 1.5 GPM/5.7 LPM)
 - d. ES - Economy Soft Flow w/ Ball Joint (Flow Rate = 2.0 GPM/7.6 LPM)
 4. Valve Type:
 - a. Hot/Tempered and Cold Supplies:
 - 1) EF - Equa-Flo Pressure Balancing Valve
 - 2) HD - Equa-Flo HD Pressure Balancing Valve
 - 3) TMV - Thermostatic Mixing Valve
 - b. Single Tempered/Cold Supply:
 - 1) AST - Air Pushbutton
 - 2) SV - Single Compression Valve
 5. Drain: Provide standard column slot drain with clamping ring type. Shroud and anchor and other kit to be provide for proper installation as required by the manufacturer.

2.8 ELECTRIC DRINKING FOUNTAIN

- A. Manufacturers:
1. Elkay Mfg.
 2. Halsey Taylor
 3. Oasis Corp.
 4. Haws.
- B. Supply Fittings Manufacturers:
1. Chicago.
 2. McGuire.
 3. Brasscraft.

4. Zurn.

- C. All electric water coolers shall meet the latest mandates and requirements for lead free required by law that goes into effect January 2014.
- D. Fountain: (EDF-1) [Indoor With Bottle Filler](#)
 - 1. ARI 1010; (ADA) Hydroboost bottle filling station, bi-level cooler, wall mount, non-filtered 8 GPH Stainless. Mechanically activated, sanitary sensor activated, green counter, laminar flow, antimicrobial, real drain. Electronic bottle filler sensor with mechanical front and side bubbler pushbar. Halsey Taylor Model HTHB-HAC8BLSS-NF provide as indicated on plumbing fixture schedule.
 - 2. Capacity: 7.6 gph of water with inlet at 80 degrees F and room temperature of 90 degrees Fahrenheit.
 - 3. Electrical: 115V / 60HZ. Maximum 1/5 hp compressor, cord and plug for connection to electric wiring system including grounding connector.
 - 4. Provide cane touch apron, Halsey Taylor Model 42522 for HAC Series or provide as indicated on plumbing fixture schedule.
 - 5. Provide cane touch apron.

2.9 EMERGENCY EYE AND FACE WASH (EW-1)

- A. Manufacturers:
 - 1. Encon Safety Products
 - 2. Haws.
 - 3. Guardian Safety Equipment
- B. ANSI Z358.1; Barrier Free, pedestal mounted eye/face wash with stainless steel bowl, Schedule 40 galvanized pipe and fittings, 1/2" U.S. made chrome-plated stay-open ball valve, powder-coated cast aluminum flag handle and floor flange. Unit shall have (4) polypropylene GS-Plus™ spray heads with integral "flip-top" dust covers, filters and 1.6 GPM flow control orifices mounted on a chrome-plated brass eyewash assembly. Unit shall include ANSI compliant sign. Tailpiece and chrome plated brass P-trap supplied by others. Furnish universal emergency sign. ADA Guardian Model GBF-1704 BC w/ G6020 or provide as indicated on plumbing fixture schedule. [For ADA](#)
- C. ANSI Z358.1; Pedestal mounted, eye/face wash with stainless steel bowl, Schedule 40 galvanized pipe and fittings, 1/2" U.S. made chrome-plated brass stay-open ball valve, powder-coated cast aluminum flag handle and floor flange. Unit shall have (4) polypropylene GS-Plus™ spray heads with integral "flip-top" dust covers, filters and 1.6 GPM flow control orifices mounted on a chrome-plated brass eyewash assembly. Unit shall include ANSI compliant sign. Guardian Model G-1704 BC w/ G3600LF or provide as indicated on plumbing fixture schedule. [For Non – ADA](#)

2.10 EMERGENCY COMBINATION SHOWER WITH EYE AND FACE WASH (EW-#)

- A. Manufacturers:
 - 1. Encon Safety Products

2. Haws Drinking Faucet Co.
 3. Guardian Safety Equipment
 4. Speakman
 5. Or approved equal
- B. Barrier Free, all stainless steel construction, corrosion resistant, combination eye/face wash and shower safety station with stainless steel shower head, stainless steel bowl, stainless steel flag handle and floor flange, 1 ¼" IPS Schedule 40 stainless steel pipe and fittings, 1" IPS and ½" IPS U.S. made stainless steel stay open ball valves, and polished stainless steel pull rod. Unit shall have (4) polypropylene 'GS Plus' spray heads with integral "flip-top" dust covers, filters, and 1.8-GPM flow control orifices mounted on a stainless steel head assembly. Unit shall include ANSI compliant sign.
- C. Performance: Unit complies with ADA requirements for accessibility by handicapped persons. Unit shall meet or exceed ANSI Z358.1 – 2004, and come with a full 2-year warranty.
- D. Fixture:
1. (EW-2): Guardian Equipment GBF1994 or provide as indicated on plumbing fixture schedule.
 2. (EW-3): Guardian Equipment GBF 2150SSH-PCC for all Lab Classrooms.
 3. (EW-4): Guardian Equipment GBF1909SSH-GC (orange) For Central Plant and unfinished area.
- E. Alarm Option:
1. AP275-200 alarm unit, with light and horn. (blue color light) Light and horn shall be installed in corridor outside of science lab (120 VAC, 0.5 AMP).
 2. Locate the blue light in the ceiling of the main corridor area directly outside room where emergency shower is installed. Provide one light per shower/valve configuration. Guardian AP280-235 (120v/1/60hz – 0.11 amp) for GBF 2150SSH-GC and Guardian AP280-230 (120v/1/60hz – 0.11 amp) for GBF 1909SSH-GC
- F. Hot water Option: TMV G3800LF Thermostatic mixing valve per ANSI Z358.1-2014.
- G. Supply and Waste Piping: 1-1/4 inch galvanized steel pipe pedestal with floor flange.
- H. Furnish universal emergency sign.

2.11 SERVICE SINKS (SS-1)

- A. Manufacturers:
1. Fixture Manufacturers:
 - a. Fiat Products
 - b. Florestone
 - c. Stern Williams

2. Fixture Trim Manufacturers:
 - a. Chicago Faucet Co.
 - b. Fiat Products
 - c. Stern Williams
 - d. T & S Brass & Bronze Works Inc.

- B. SS-1: Single bowl 24 x 24 x 10 inch high. Receptor composed of pearl grey marble chips and white Portland cement ground smooth, grouted and sealed to resist stains, floor mounted, with 1-1/4 inch wide shoulders, vinyl bumper guard, stainless steel dome strainer. Stern Williams Model MTB-2424 or provide as indicated on plumbing fixture schedule.

- C. Accessories:
 1. Sink Fittings: Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges. Stern Williams Model T-10-VB.
 2. Three (3) feet of 5/8 inch diameter plain end reinforced synthetic hose with stainless steel wall bracket. Stern Williams Model T-35.
 3. Mop hanger. Stern Williams Model T-40.
 4. Or provide as indicated on plumbing fixture schedule.

- D. SS-2: 12" corner type w/drop front, bowl 32 x 32 x 12 inch high. Receptor composed of pearl grey marble chips and white Portland cement ground smooth, grouted and sealed to resist stains, floor mounted, with 1-1/4 inch wide shoulders, vinyl bumper guard, stainless steel dome strainer, floor mounted. Stern Williams Model SBC-1725 or provide as indicated on plumbing fixture schedule.

- E. Accessories:
 1. Sink Fittings: Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges. Stern Williams Model T-10-VB.
 2. Three (3) feet of 5/8 inch diameter plain end reinforced synthetic hose with stainless steel wall bracket. Stern Williams Model T-35.
 3. Mop hanger. Stern Williams Model T-40.
 4. Or provide as indicated on plumbing fixture schedule

2.12 FLOOR DRAINS

- A. Manufacturers:
 1. Josam Mfg.,
 2. Jay R. Smith Mfg.,
 3. Wade Spec. Products
 4. Zurn Industries

5. Mifab
 6. Watts
- B. Floor Drain (FD-1): ASME A112.21.1; Top round floor drain, lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer. Zurn ZN-415-BZ1 (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

2.13 FLOOR SINKS

- A. Manufacturers:
1. Josam Mfg.
 2. Jay R. Smith Mfg.
 3. Wade Spec. Products
 4. Zurn Industries
 5. Mifab
 6. Watts
- B. Floor Sink (FS-1): Cast iron body with integral seepage pan, acid resistant interior, nickel bronze rim and secured 1/2 grate. Aluminum dome bottom strainer and eight (8) inch square top. Zurn ZN-1910-K Series (Vandal-Proof Secured Top) or provide as indicated on plumbing fixture schedule.

2.14 TRAP SEAL PRIMERS

- A. Manufacturers:
1. PPP Inc.
 2. Jay R. Smith Mfg.
 3. Siouxchief
 4. Zurn Industries
 5. Mifab
 6. Watts
 7. Sloan
- B. Trap Seal Primers-Pressure Drop Type (TP-1)
1. Adjustable to the static line pressure by use of the adjusting screw. System operating range is 20 psi minimum to 80 psi. The trap Primer is to be connected to a cold water supply with isolation valve.
 - a. PPP Model P1-500 will prime 1-4 floor drains using DU-U Distribution unit.

- b. PPP Model P2-500 will prime 1-2 floor drains using DU-U Distribution unit.
- C. Trap Seal Primers-Flush Valve Type (TP-2)
 - 1. Vacuum breaker trap primer attached to water closet flush valve, similar to Sloan VBF-72-A.
- D. Trap Seal Primer: (TP-3), Jay R. Smith 2699 Series.

2.15 CLEANOUTS

- A. Cleanouts shall be provided where indicated on Drawings and elsewhere as required by code.
 - 1. Cleanouts in pipelines shall consist of cast iron ferrule and heavy duty cleanout plug with square head as scheduled on the Drawings. Where piping is concealed in floors or walls cleanouts shall be installed in or near surface of floor or walls and have countersunk plugs with covers
- B. Cleanouts shall be provided at the base of the stack on all sanitary, waste and drainage stacks. Base of stack cleanouts on piping located within walls or partitions shall be cast iron cleanout tee with countersunk plug and chromium-plated round access cover, J.R. Smith figure or approved equal.
- C. Manufacturers:
 - 1. Josam Mfg.
 - 2. Jay R. Smith Mfg.
 - 3. Wade Spec. Products
 - 4. Zurn Industries
 - 5. Mifab
 - 6. Watts
- D. Floor, Outdoors: Coated cast iron body with gasket seal ABS plug and round cast iron scoriated non-skid cover. Jay R. Smith, Model 4220-F-C-U.
- E. Floor, Indoors (CO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round nickel bronze scoriated cover in service areas. Jay R. Smith, Model 4025 – F-C-U.
- F. Wall Cleanout (WCO): Line type with lacquered cast iron body with bronze taper thread plug and round stainless steel access cover secured with vandal proof screw. Jay R. Smith Model 4420-U.
- G. Floor, Stainless Steel Indoors (CO): Coated cast iron body with gasket seal ABS plug, threaded top assembly with round stainless steel scoriated cover in service areas. Jay R. Smith Model 9760 Series.

2.16 ROOF DRAINS

- A. Roof Drain (RD-1):

1. Assembly: ASME A112.21.2M and ASME 112.3.1 or ASME 112.6.4
 2. Body: Lacquered cast iron with sump.
 3. Strainer: Removable aluminum dome with vandal proof screws.
 4. Accessories: Coordinate with roofing type, provide all required accessories:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Under deck ring with wide flange.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Adjustable threaded extensions collar, bearing pan with SS hardware.
 5. Model:
 - a. Josam – 21500-AE-CR-1-26
 - b. J. R. Smith – 1015AD-C-R
 - c. Zurn – ZA100-C-EA-R
 - d. Wade – 3000-AE-189
 - e. Mifab – R1200-EU-B-M-80
- B. Overflow Roof Drain (OD-1):
1. Assembly: ASME A112.21.2M and ASME 112.3.1 or ASME 112.6.4.
 2. Body: Lacquered cast iron with sump.
 3. Strainer: Removable aluminum dome with vandal proof screws.
 4. Waterdam extended to two (2) inches above flood elevation.
 5. Accessories: Coordinate with roofing type:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Adjustable threaded extensions collar, bearing pan with SS hardware.
 6. Model:
 - a. Josam – 21500-AE-CR-1-26
 - b. J. R. Smith – 1015AD-C-R
 - c. Zurn – ZA100-C-EA-R
 - d. Wade – 3000-AE-189
 - e. Mifab – R1200-EU-B-M-80

2.17 HOSE BIBS

- A. Manufacturers:
1. Josam Mfg.
 2. Jay R. Smith Mfg.
 3. Woodford
 4. Zurn Industries

5. Chicago
6. Wade
- B. HB-1:
 1. Manufacturers: Woodford Model B24 or provide as indicated on plumbing fixture schedule.
 2. Interior: Polish brass, anti-siphon, vacuum breaker, enclosed in flush mounted wall box and adjustable brass nut with deep stem guard.
- C. HB-2:
 1. Manufacturers: Woodford Model B65, or provide as indicated on plumbing fixture schedule.
 2. Interior: Polish brass Bronze, automatic draining freezeless wall hydrant, single check hose connection anti-siphon vacuum breakers, hydrants drain as handle shut off , permanent type brass valve body with hemispherical seating surface.
- D. HB-3:
 1. Manufacturers: Woodford Model 24 or provide as indicated on plumbing fixture schedule.
 2. Interior: Polish brass, anti-siphon, vacuum breaker and adjustable brass nut with deep stem guard.

2.18 WALL HYDRANTS

- A. Manufacturers:
 1. Josam Mfg.
 2. Jay R. Smith Mfg.
 3. Woodford.
 4. Zurn Industries
 5. Mifab
 6. Watts
- B. Exterior Wall Hydrant (WH-1):
 1. Woodford RB65, Non-Freeze, or provide as indicated on plumbing fixture schedule.
 2. ASSE 1019; Chrome, non-freeze, self-draining type with lockable recessed box hose thread spout, hand wheel locks shield and removable key, and integral vacuum breaker.

2.19 RECESSED VALVE BOX

- A. Manufacturers: Guy Gray, or approved equal.

- B. RVB-1, Refrigerator/Ice Machine: Stainless steel preformed rough-in box with brass valves with wheel handle slip in finishing cover. IPS Model SSMIB8AB.
- C. RVB-2, Washing Machine: Galvanized steel preformed rough-in box with brass long shank valves with wheel handles, valves with single lever handle, socket for two (2) inch waste, slip in finishing cover. IPS Model SSWB-3.

2.20 DOWNSPOUT OVERFLOW

- A. Nozzle Style:
 - 1. Manufacturers: Jay R. Smith 1770 Series or provide as indicated on plumbing fixture schedule.
 - 2. Product Description: Cast bronze body and wall flange round with offset bottom section.
- B. Hinged Cover Style:
 - 1. Manufacturers: Jay R. Smith 1775-U Series or provide as indicated on plumbing fixture schedule.
 - 2. Product Description: Fabricated Type 304 Stainless Steel Downspout Cover with Hinged Perforated Cover.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 31 13 - Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key or screwdriver stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.
- F. For ADA accessible water closets, install flush valve with handle to wide side of stall.

- G. Emergency Shower: Provide a floor drain at each shower installation. Jay R. Smith Model 2005-A07NB-P or provide as indicated on plumbing fixture schedule.
- H. Ice maker: Provide floor sink and cold-water outlet RVB-1 to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- I. Water Heater: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- J. Janitor Closet: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- K. Commercial Washer: Provide floor drain to each location. Coordinate with Architecture Drawings prior to rough-in. Ensure drains are located at low point(s) of floor slope.
- L. Washing Machine: Provide Hot and cold water outlet RVB-2 to each location. Coordinate with Architecture Drawings prior to rough-in.
- M. Provide power wiring, including control power transformers as required for all sensor type fixtures.
- N. Bolt carriers to the floor.
- O. All sinks shall have an offset rear centered drain.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. Hot water temperature outlet at each sink and lavatory shall be adjusted to 105 degree F maximum except for water supplying clothes washing machines and kitchen equipment which shall supply with 140 degree F.

3.6 CLEANING

- A. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Do not permit use of fixtures before final acceptance.

END OF SECTION 22 40 00

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested, and performing their intended function.

1.3 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the applicable codes, specifications, local ordinances, industry standards, utility company regulations, nationally accepted codes.
- B. All materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the Architect or Engineer not to be an inherent part of the systems as designed without additional cost to the Owner.

1.4 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished, and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted, and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical

Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.

- F. The mechanical trades shall coordinate with the electrical contractor to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment scheduled and shown on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical contractor shall be responsible for added cost and coordination with the electrical subcontractor. The mechanical contractor shall pay the electrical trades for the cost of the additional work and materials except for changes by addendum.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

1.5 DRAWINGS

- A. The drawings are schematic in nature but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the mechanical, plumbing and fire protection equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment that the Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of pipes and ducts, or to indicate all offsets and fittings or supports, but rather to indicate approximate layout.
- B. The mechanical, plumbing and fire protection Drawings are necessarily diagrammatic in character and cannot show every connection in detail in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical, electrical, plumbing and fire protection Drawings do not give exact details as to the elevation of pipe, conduit, and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed piping and ductwork are generally intended to be installed true and square to the building construction and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.6 SUBMITTALS

- A. Provide shop drawings and complete product data as indicated in each specification section.
- B. Coordination Drawings: Using the mechanical ductwork shop drawings as a basis, provide a composite set of AutoCAD drawings in which the major mechanical, plumbing and fire protection equipment, ductwork and piping are superimposed on the architectural reflected ceiling plan and structural framing plan. Include spot elevations of bottom of steel along with finished ceiling height. Prepare at 1/8-inch scale or larger, one drawing per building area. Provide 1/4-inch scale enlargements of locations where special attention to rough-in dimensions as required to ensure all systems will fit within the available space. Obtain approval of coordination drawings prior to duct fabrication and mechanical system hanger rough-ins.
- C. Shop Drawings will be reviewed and returned to the Contractor with one of the following categories:
 - 1. **Reviewed:** No further submittal action is required. Submittal to be included in O & M Manual.
 - 2. **Revise and Resubmit:** Contractor to resubmit submittal as indicated in comments section of Engineer's Submittal Cover Letter.
 - 3. **Rejected:** Contractor to resubmit new submittal when alternate or substitution is not approved and be required to furnished product named in Specification and or Drawings.
 - 4. **Furnish as Corrected:** Contractor to submit letter verifying that required corrections noted on Engineer's Submittal Cover Letter have been received and complied with by manufacturer. If equipment on site is not in compliance with corrections noted, contractor shall be responsible for the cost of removing and replacing equipment.
- D. Materials and equipment which are purchased or installed without Submittal review and approval will be removed and replaced with specified equipment at Contractor's expense.
- E. Provide a specification review that consists of a copy of related specification section with notations indicating compliance or deviation with each element of specification.

1.7 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability, or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of seven (7) business days prior to the date for receipt of proposals. Each such request shall include a specification line by line review annotated to certify compliance, the name of the

manufacturer and model, material or equipment for which it is to be substituted and a complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation. The Engineers decision of approval or disapproval of a proposed substitution shall be final.

- C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Engineer and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- E. Availability of specified items:
 - 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
 - 2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
 - 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.
 - 4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- F. A request constitutes a representation that Offeror:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.
- G. **No substitutions will be considered after the Award of Contract.**

1.8 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements and each specification section.

1.9 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the mechanical, plumbing or fire protection system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8-inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.
- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Equipment listed below shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. Contractor shall adequately protect equipment such as but not limited to: Chillers, Air Handling Units, Fan coil Units, Roof top Units, Air Terminal Units, Boilers, Pumps, Air Devices, exhaust fans, variable frequency drives, ductwork, duct insulation, piping insulation, hydronic piping, air duct accessories, unit heaters, etc. from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging; original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- D. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- E. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.11 GENERAL ELECTRICAL REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.
- B. Electrical materials and work provided shall be in accordance with Division 26.

- C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.

1.12 ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

- A. Mechanical equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL and shall meet the latest edition of the National Electrical Code.
- B. Unless otherwise specified, the electrical supply being furnished is a 460-volt, 3 phase, 3 wire, 60 hertz source. No neutral connection is available from the 460-volt source. The manufacturer shall include any transformers for equipment requiring other voltages (277volt, 220-volt, 120-volt, 24 volt, etc.).
- C. Electric Motors:
 - 1. For each piece of equipment requiring electric drive, provide a motor having started and running characteristics consistent with torque and speed requirements of the driven machine.
 - 2. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of driven equipment on shop drawings.
 - 3. Each motor shall be furnished in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
 - 4. Contractor shall verify electrical characteristics of each motor with electrical drawings.
 - 5. Motors which are shipped loose from equipment shall be set by supplying subcontractor.
 - 6. Alignment of motors factory coupled to equipment and motors field coupled to equipment shall be rechecked by millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and again after 48 hours of operation in designed service.
 - 7. Where possible, motors shall be factory mounted.

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 OWNER INSTRUCTION - GENERAL

- A. Installing Contractor shall coordinate and provide on-site Owner training for all new equipment by factory trained specialists for all Mechanical and Plumbing equipment in two (2) separate training meetings. One (1) training session shall be prior to Owner's acceptance and occupancy, and the other training session shall occur (30) thirty days later. Sign-in sheets are required for both meetings and shall be included in close out submittals.

- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.
- D. Refer to individual equipment specifications for additional training requirements.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes single and three phase motors for application on equipment provided under other sections and for motors furnished loose to Project.
- B. General: Provide motors for all equipment. Select for starting torque and starting current suitable for equipment loads and starting equipment. Horsepower rating shown on drawings are required, but motor must not be loaded more than 1.0 x nameplate horsepower. Provide larger motor if required to stay within this limitation and include all costs for any required increases in electrical system.
- C. Electrical Characteristics: Provide nameplate ratings same as circuit voltage indicated on electrical drawings. Coordinate to give proper operation with starting equipment scheduled. See Division 26.

1.3 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 – Motors and Generators.
- C. All motors furnished shall be designed, manufactured, and tested in accordance with the latest applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the latest applicable sections of NEMA Standard No. MG-1. Motors must meet or exceed the rebate levels for premium efficiency Motors established by the Consortium for Energy Efficiency (CEE).

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

- B. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.
- C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.1 ELECTRIC MOTORS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Baldor
 - 2. Marathon
 - 3. General Electric
 - 4. Weg
 - 5. A.O. Smith
- B. Motors 3/4 hp and Larger: Three-phase motor as specified below.
- C. Motors Smaller Than 3/4 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.
- D. All motors controlled by a Variable Frequency Drive shall be NEMA MG-1 Section 31 Inverter-Fed Rated.
- E. Three-phase Motors: NEMA MG-1, Design B, class H premium, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.
 - 1. Service Factor: 1.15
 - 2. Enclosure: Concealed Indoor: ODP, Exposed Indoor: Guarded ODP, Outdoor: Type II TEFC, Outdoor Weather Protected: Type I TEAO.
 - 3. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - 4. Insulation System: NEMA Class F.
 - 5. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 - 6. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum ABMA 9, L-10 life of 40,000 hours. Calculate bearing load with NEMA standard shaft extension. Stamp bearing sized on nameplate.
 - 7. Sound Power Levels: Conform to NEMA MG 1.
 - 8. Factory finish starters shall be provided with integral phase failure protection to shut down motor upon loss of an electrical phase and automatically reset upon return of 3 phase power.

- F. Single Phase Motors:
 - 1. Permanent split-capacitor type where available, otherwise use split-phase start / capacitor run or capacitor start / capacitor run motor.
 - 2. Service Factor: 1.35.
- G. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.2 SOURCE QUALITY CONTROL

- A. General: All motor starters and magnetic contactors are specified in Division 26, except as follows:
 - 1. Starters and motors specified as part of a packaged piece of equipment.
 - 2. Centrifugal chillers which are provided with remote mounted starters under the chiller specification.
 - 3. Variable speed controllers for variable volume air handling units and cooling towers.
- B. Provide a tabulation of motors with all pertinent information required for properly rated motor controllers to be provided under Division 26.
- C. Provide a tabulation of matched motors and starters provided under Division 23.
- D. Variable speed motors controlled by variable frequency drives in general shall be of standard design called out in this specification. The manufacturer shall be notified on the requisition that the motor will be used in conjunction with a variable frequency drive and its type of frequency generation. It shall be the responsibility of the motor manufacturer to ensure that this motor will be capable of operating under the torque requirements and speed range within temperature specifications. The normal speed range shall be 4 to 1 ratio. The motor / drive system shall be capable of maintaining full torque throughout. The motors specified for variable speed application shall be capable of operating at 90 hertz maximum frequency as a minimum requirement but at reduced torque's above 60 HZ.
- E. Efficiency: Minimum full load efficiency shall be as follows:

Open Drip-Proof (ODP)				Totally Enclosed Fan Cooled (TEFC)			
	1200 RPM	1800 RPM	3600 RPM		1200 RPM	1800 RPM	3600 RPM
HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency	HP	Minimum Efficiency	Minimum Efficiency	Minimum Efficiency
1	82.5	85.5	77.0	1	82.5	85.5	77.0
1.5	86.5	86.5	84.0	1.5	87.5	86.5	84.0
2	87.5	86.5	85.5	2	88.5	86.5	85.5
3	88.5	89.5	85.5	3	89.5	89.5	86.5
5	89.5	89.5	86.5	5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	7.5	91.0	91.7	89.5
10	91.7	91.7	89.5	10	91.0	91.7	90.2

15	91.7	93.0	90.2	15	91.7	92.4	91.0
20	92.4	93.0	91.0	20	91.7	93.0	91.0
25	93.0	93.6	91.7	25	93.0	93.6	91.7
30	93.6	94.1	91.7	30	93.0	93.6	91.7
40	94.1	94.1	92.4	40	94.1	94.1	92.4
50	94.1	94.5	93.0	50	94.1	94.5	93.0
60	94.5	95.0	93.6	60	94.5	95.0	93.6
75	94.5	95.0	93.6	75	94.5	95.4	93.6
100	95.0	95.4	93.6	100	95.0	95.4	94.1
125	95.0	95.4	94.1	125	95.0	95.4	95.0
150	95.4	95.8	94.1	150	95.8	95.8	95.0
200	95.4	95.8	95.0	200	95.8	96.2	95.4

PART 3 - EXECUTION

3.1 REQUIREMENTS

- A. All equipment shall be installed in accordance with the manufacturer's recommendations and printed installation instructions.
- B. All items required for a complete and proper installation are not necessarily indicated in the plans or in the specifications. Contractor's price shall include all items required as per manufacturer's requirements.

3.2 INSTALLATION

- A. General: Install in a professional manner. Any part of parts not meeting this requirement shall be replaced or rebuilt without extra expense.
- B. Install rotating equipment in static and dynamic balance.
- C. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building. Refer to Section 23 05 48.
- D. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.

END OF SECTION 23 05 13

SECTION 23 05 14 - VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. The drive shall be designed specifically for variable torque applications. It is required that the drive manufacturer has an existing independent service organization.
- B. The drive and all necessary controls as herein specified shall be supplied by the drive Manufacturer. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of ten (10) years.
- C. For Air Handling Units with multiple fans (Fan Array) and motors, VFD manufacturer shall provide internal individual motor overloads to match quantity of fan motors. Refer to Air Handling Unit Schedule for fan motor quantity

1.3 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Institute of Electrical and Electronic Engineers (IEEE)
 - a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
 - 2. Underwriter's laboratories
 - a. UL508C
 - 3. National Electrical Manufacturer's Association (NEMA)
 - a. ICS 7.0, AC Adjustable Speed Drives
 - 4. IEC 16800 Parts 1 and 2
- B. Testing:
 - 1. All printed circuit boards shall be completely tested and burned-in before being assembled into the completed VFD. The VFD shall then be subjected to a computerized systems test (cold), burn-in, and computerized systems test (hot). The burn-in shall be at 104 degrees Fahrenheit at full rated load, on a motor. Drive input power shall be continuously cycled for maximum stress and thermal variation.
 - 2. All testing and manufacturing procedures shall be ISO 9001 certified.
- C. Failure Analysis:

1. VFD manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray of components, and decap or delaminate of components and analyze failures within the component.

D. Qualifications:

- a. VFD's and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to be UL listed are not acceptable.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Submit VFD's only after coordination with approved Air Handling Units, Pumps, and Cooling Tower Submittals (If applicable).
- C. All Variable Frequency Drives serving various equipment such as but not limited to: Air handling Units, Pumps and Cooling towers shall be supplied by the same manufacturer.
- D. Submittals shall include, as a minimum, the following information:
 1. Outline Dimensions
 2. Weight
 3. Compliance to IEEE 519 - harmonic analysis for particular job site including total harmonic voltage distortion and total harmonic current distortion.
 - a. The VFD manufacture shall provide calculations, specific to the installation, showing total harmonic voltage distortion is less than five (5) percent. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519 (latest version), guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance of this calculation must be completed prior VFD installation.
 - b. If the voltage THD exceeds five (5) percent, the VFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level.

1.5 WARRANTY

- A. Warranty shall be (2) two years and shall begin from date of Certificate of Substantial Completion. The warranty shall include all parts, labor, travel time and expenses to provide on-site warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in manufacturer's original, unopened containers with identification labels intact.

- B. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.7 MANUFACTURERS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. ABB.
 - 2. Yaskawa.

PART 2 - PRODUCTS

2.1 ADJUSTABLE FREQUENCY DRIVES

- A. The adjustable frequency drives (VFD's) shall be solid state, with a Pulse Width Modulated (PWM) output. The VFD package as specified herein shall be enclosed in a NEMA 1 enclosure (NEMA 3R if outdoors or unconditioned space), completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier (to prevent input line notching), Integral Line Reactor(s), Capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output switching device. The drive efficiency shall be 97 percent or better at full speed and full load. Fundamental power factor shall be 0.98 at all speeds and loads.
 - 1. Input 480 VAC +/- 10 percent, 3 phase, 48-63 Hz. The overvoltage trip level shall be 30 percent over the nominal, and the under-voltage trip level shall be 35 percent over the nominal voltage as a minimum.
 - 2. Output Frequency 0 to 250 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.
 - 3. Environmental operating conditions: 0 to 104 Degree Fahrenheit, 0 to 3300 feet above sea level, less than 95 percent humidity, non-condensing.
 - 4. Conditioned indoors enclosure shall be rated NEMA 1 and shall be UL listed as a plenum rated drive. Drives without this rating are not acceptable.
 - 5. VFD's located in un-conditioned spaces or outdoors shall have rated NEMA 4X enclosure and shall be UL listed as a plenum rated drive. Drives without this rating are not acceptable.
- B. All VFD's shall have the following features:

1. All VFD's shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable, capable of remote mounting, and shall have its own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFD's.
2. The keypad shall include Hand-Off-Auto membrane selections. When in "Hand", the VFD will be started, and the speed will be controlled from the up/down arrows. When in "Off", the VFD will be stopped. When in "Auto", the VFD will start via an external contact closure and the VFD speed will be controlled via an external speed reference. The drive shall incorporate "bump less transfer" of speed reference when switching between "Auto" and "Hand" modes and vice-versa.
3. The VFD's shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to ACS400-US-reprogram all parameters and customer interfaces for a particular application to reduce programming time.
4. The VFD shall have the ability to automatically restart after an over current, overvoltage, under voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.
5. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start). The VFD shall also be capable of DC injection braking at start to stop a reverse spinning motor prior to ramp.
6. The VFD shall be equipped with an automatic extended control power loss ride-through circuit, which will utilize the inertia of the load to keep the drive powered. Minimum power loss ride-through shall be one-cycle, based on full load and no inertia. Typical control power loss ride-through for a fan load shall be 2 seconds minimum.
7. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.
8. The customer terminal strip shall be isolated from the line and ground.
9. The drive shall employ current limit circuits to provide trip free operation:
 - a. The Slow Current Regulation limit circuit shall be adjustable to 150 percent (minimum) of the VFD's normal duty current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.
 - b. The Current Switch-off limit shall be fixed at 350 percent (minimum, instantaneous) of the VFD's normal duty current rating.

10. The overload rating of the drive shall be 110 percent of its normal duty current rating for one (1) minute in every ten (10) minutes. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.
11. The VFD shall have an integral Line Reactor(s) to reduce the harmonics to the power line and to increase the fundamental power factor. The minimum impedance shall be three (3) percent.
12. The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false under load condition.
13. The VFD shall have programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped from the level of a process feedback signal.
14. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection shall be provided in both drive and bypass modes.
15. The following operators shall be provided:
 - a. Bypass Hand-Off-Auto
 - b. Drive mode selector
 - c. Bypass mode selector
 - d. Bypass fault reset
16. The following indicating lights (LED type) shall be provided:
 - a. Power-on
 - b. External fault
 - c. Drive mode selected
 - d. Bypass mode selected
 - e. Drive running
 - f. Bypass running
 - g. Drive fault
 - h. Bypass fault
 - i. Automatic transfer to bypass selected
17. Customer Interlock Terminal Strip: Provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All

external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes.

18. The following relay (form C) outputs from the bypass shall be provided.
 - a. Drive run
 - b. Bypass run
 - c. Drive fault Bypass fault (motor overload or under load (broken belt))
 19. Automatic or manual bypass (field selectable)
 20. Manual or automatic bypass fault (field selectable)
 21. Dedicated digital input that will transfer motor from VFD mode to bypass mode upon dry contact closure.
 22. Door interlocked pad lockable circuit breaker which will disconnect all input power from the drive and all internally mounted options.
 23. Fast acting semi-conductor fuses exclusive to the VFD - fast acting semi-conductor fuses allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the Bypass will not be accepted.
 24. Class 10 or 20 (selectable) electronic motor overload protection shall be included in the microprocessor bypass to protect the motor in bypass mode.
- C. All VFD's to have the following adjustments:
1. Two (2) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
 2. PID Setpoint controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The auxiliary power supply shall have overload and over current protection. The PID setpoint shall be adjustable from the VFD keypad, analog inputs, or over the communications bus.
 3. Two (2) programmable analog inputs shall accept a current or voltage signal for speed reference or for reference and actual (feedback) signals for PID controller. Analog inputs shall include a filter; programmable from 0.01 to 10 seconds to remove any oscillation in the input signal. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0 - 20 ma and 0 - 10 Volts. Additionally, the reference must be able to be scaled so that maximum reference can represent a frequency less than 60 Hz, without lowering the drive maximum frequency below 60 Hz. Process variables shall be modifiable by math functions such as multiplication and division between the two signals (fan tracking), high/low select, as well as inverted follower.
 4. Five (5) programmable digital inputs for maximum flexibility in interfacing with external devices. One digital input is to be utilized as a customer safety

connection point for fire, freeze, and smoke interlocks (Enable). Upon remote, customer reset (reclosure of interlock) drive is to resume normal operation.

5. One (1) programmable analog output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.
 6. Two (2) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; Continuous current rating 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable. Relays shall be capable of programmable on and off delay times.
 7. Seven (7) programmable preset speeds.
 8. Two independently adjustable accel and decel ramps. These ramp times shall be adjustable from 1 to 1800 seconds.
 9. The VFD shall Ramp or Coast to a stop, as selected by the user.
- D. The following operating information displays shall be standard on the VFD digital display. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of two operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
1. Output Frequency
 2. Motor Speed (RPM, percent, or Engineering units)
 3. Motor Current
 4. Calculated Motor Torque
 5. Calculated Motor Power (kW)
 6. DC Bus Voltage
 7. Output Voltage
 8. Heat sink Temperature (0°F)
 9. Analog Input Values
 10. Analog Output Value
 11. Keypad Reference Values
 12. Elapsed Time Meter (resettable)
 13. kWh meter (resettable)
 14. mWh meter
 15. Digital input status

16. Digital output status
- E. The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words (alphanumeric codes are not acceptable).
1. Over current trip 350 percent instantaneous (170 percent RMS) of the VFD's variable torque.
 2. Current rating.
 3. Overvoltage trip 130 percent of the VFD's rated voltage.
 4. Under voltage trip 65 percent of the VFD's rated voltage.
 5. Over temperature +90 degrees Celsius.
 6. Ground Fault either running or at start.
 7. Adaptable Electronic Motor Overload (I 2 t). The Electronic Motor Overload protection shall protect the motor based on speed, load curve, and external fan parameter. Circuits, which are not speed dependant, are unacceptable. The electronic motor overload protection shall be UL approved for this function.
- F. Speed Command Input shall be via:
1. Keypad.
 2. Two Analog inputs, each capable of accepting a 0-20mA, 4-20mA, 0-10V, 2-10V signal.
 3. Floating point input shall accept a three-wire input from a Dwyer Photohelic (or equivalent type) instrument.
 4. Serial Communications
- G. Serial Communications
1. The VFD shall have an RS-485 port as standard. The standard protocol shall be BACnet. Optional protocols that must be available are Johnson Controls N2 bus, Siemens Building Technologies FLN, LonWorks, Profibus and DeviceNet.
 2. Serial communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, and accel/decel time adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), percent torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information. Additionally, remote (LAN) VFD fault reset shall be possible. A minimum of 15 field parameters shall be capable of being monitored.
 3. The VFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. The serial communications interface shall allow for DO (relay)

control and AO (analog) control. In addition, all drive digital and analog inputs shall be capable of being monitored by the DDC system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive-in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
- B. Power wiring shall be completed by the electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.2 START-UP

- A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.3 PRODUCT SUPPORT

- A. Factory trained application engineering and service personnel that are thoroughly familiar with drive products offered shall be locally available at both the specifying and installation locations.

END OF SECTION 23 05 14

SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Expansion joints.
 - 2. Pipe alignment guides.
 - 3. Pipe anchors.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for piping hangers and supports.
 - 2. Section 23 21 13 - Hydronic Piping: Product and installation requirements for piping used in heating and cooling systems.

1.3 DESIGN REQUIREMENTS

- A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.
- B. Expansion Compensation Design Criteria:
 - 1. Installation Temperature: 50 degrees Fahrenheit.
 - 2. Hot Water Heating System Temperature: 210 degrees Fahrenheit.
 - 3. Domestic Hot Water: 140 degrees Fahrenheit.
 - 4. Safety Factor: 30 percent.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, expansion compensators, loops, offsets, and swing joints. Submit shop drawings sealed by a registered professional engineer.
- C. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

- D. Design Data: Indicate criteria and show calculations. Submit calculations sealed by a registered professional engineer.
- E. Manufacturer's Installation Instructions: Submit special procedures.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Welders' Certificate: Include welders' certification of compliance with AWS D1.1.
- H. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- B. Operation and Maintenance Data: Submit adjustment instructions.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.
- B. Design expansion compensating system under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
- B. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

1.9 WARRANTY

- A. Furnish five (5) year manufacturer warranty for leak free performance of packed expansion joints.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Amber / Booth
 2. Triplex
 3. Mason Industries
- B. Stainless Steel Bellows Type:
1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
 2. Maximum Compression: 1-3/4 inch.
 3. Maximum Extension: 1/4 inch.
 4. Joint: As specified for pipe joints.
 5. Size: Use pipe sized units
 6. Application: Steel piping three (3) inch and smaller.
- C. External Ring Controlled Stainless Steel Bellows Type:
1. Pressure Rating: 200 psig WOG and 250 degrees Fahrenheit.
 2. Maximum Compression: 15/16 inch.
 3. Maximum Extension: 5/16 inch.
 4. Maximum Offset: 1/8 inch.
 5. Joint: Flanged
 6. Size: Use pipe sized units
 7. Accessories: Internal flow liner.
 8. Application: Steel piping three (3) inch and larger.
- D. Double Sphere, Flexible Compensators:
1. Body: Multi-layered Kevlar tire cord fabric reinforced with EPDM cover, liner and fabric frictioning with reinforcing ring.
 2. Working Pressure: 215 psi
 3. Maximum Temperature: 250 degrees Fahrenheit.
 4. Maximum Compression: 1-1/4 inch through 6-inch pipe; 1-1/2-inch 8 inch through 12 inch; 1-1/5 inch for 14 inch.
 5. Maximum Elongation: 3/4 inch through 6-inch pipe; 1-1/2-inch 8 inch through 12 inch; 5/8 inch for 14 inch.
 6. Maximum Offset: 3/8 inch through 6-inch pipe; 7/8-inch 8 inch through 12 inch; 1 inch for 14 inch.
 7. Maximum Angular Movement: 15 degrees.
 8. Joint: Steel flanges or ductile iron pipe flanges.
 9. Size: Use pipe sized units
 10. Accessories: Control rods.
 11. Application: Steel piping two (2) inch and larger.

2.2 ACCESSORIES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:

1. Amber / Booth
 2. Triplex
 3. Mason Industries
- B. Pipe Alignment Guides: Two-piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1-inch-thick insulation, minimum 3-inch travel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install Work in accordance with ASME B31.9.
- B. Rigidly anchor pipe to building structure to prevent stresses and transfer of loading to connected equipment.
- C. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required. Refer to Section 23 05 29 for pipe hanger installation requirements.
- D. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.
- E. Provide expansion loops as indicated on Drawings.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION 23 05 16

SECTION 23 05 19 - METERS AND GAGES FOR HVAC PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pressure gages.
 - 2. Pressure gage taps.
 - 3. Stem type thermometers.
 - 4. Dial thermometer.
 - 5. Thermometer supports.
 - 6. Test plugs.
 - 7. Bladder-type expansion tanks.
 - 8. Air vents.
 - 9. Combination Dir and Air Separators.
 - 10. Strainers.
 - 11. Flow controls.
 - 12. Relief valves.
- B. Related Sections:
 - 1. Section 23 21 23 - Hydronic Pumps: Execution requirements for piping connections to products specified by this section.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Submit for manufactured products and assemblies used in this Project.
 - 1. Manufacturer's data and list indicating use, operating range, total range, accuracy, and location for manufactured components.
 - 2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
 - 3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
 - 4. Submit electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.

- D. Grooved joint couplings and fittings shall be shown on drawings and product submittals and be specifically identified with the applicable Victaulic style or series number.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and instrumentation.
- B. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer warranty for piping specialties.

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

- A. Manufacturers:
 - 1. Weiss
 - 2. Marsh Bellofram
 - 3. Weksler
 - 4. Dwyer
- B. Gage: ASME B40.1, UL 404 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Stainless steel.
 - 2. Bourdon Tube: Phosphor bronze.

3. Dial Size: 4-1/2 diameter.
4. Mid-Scale Accuracy: One (1) percent.
5. Scale: Psi.

2.2 PRESSURE GAGE TAPS

- A. Manufacturers:
 1. Weiss
 2. Marsh Bellofram
 3. Weksler
 4. Pete's Plug
 5. Schrader
- B. Needle Valve: Brass, 1/4-inch NPT for minimum 300 psi.
- C. Ball Valve: Brass 1/4-inch NPT for 250 psi.
- D. Pulsation Damper: Pressure snubber, brass with 1/4-inch NPT connections.
- E. Siphon: Brass, 1/4-inch NPT angle or straight pattern.

2.3 STEM TYPE THERMOMETERS

- A. Manufacturers:
 1. Terice
 2. Weiss
- B. Thermometer: Rigid 90°F angle, blue colored, organic, mercury fill, Valox case, brass stem, ½ NPT brass thermowell, acrylic window, lens front, magnifying tube type, scale face of aluminum, white background with black graduations and markings
 1. Scale Size: 5-1/2" long.
 2. Molded Valox - V-shaped black case.
 3. Window: Double Strength Glass
 4. Stem: Brass, 1/2-inch NPT, and 2 inches long.
 5. Accuracy: ±2% of full scale ASME B40.4 Grade A.
 6. Calibration: Both degrees Fahrenheit and degrees Celsius.

2.4 DIAL THERMOMETERS

- A. Manufacturers:
 1. Terice
 2. Weiss
- B. Thermometer: 300 stainless steel, hermetically sealed, bimetallic, silicone dampened on ranges to 300°F coil, adjustable angle, ½ NPT, double strength glass window, balanced, black finish pointer, dial face of aluminum, white background with black and blue graduations and markings.

1. Dial Size: 5-inch diameter dial.
2. Window: Double strength glass.
3. Stem: 300 Stainless Steel, 1/4" diameter NPT, 2-1/2" long.
4. Length of Capillary: Minimum five (5) feet.
5. Accuracy: $\pm 1\%$ of full scale ASME B40.4 Grade A.
6. Calibration: Both degrees Fahrenheit and degrees Celsius.

2.5 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions, and with cap and chain.
- B. Flange: Three (3) inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 TEST PLUGS

- A. Manufacturers:
 1. Pete's Plug
- B. 1/4-inch NPT or 1/2-inch NPT brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with:
 1. Neoprene core for temperatures up to 200 degrees F.
- C. Test Kit:
 1. Carrying case, internally padded, and fitted containing:
 - a. One 2-1/2 inch 3-1/2-inch diameter pressure gages.
 - b. Two gage adapters with 1/8-inch probes.
 - c. Two 1-1/2-inch dial thermometers.

2.7 BLADDER-TYPE EXPANSION TANKS

- A. Manufacturers:
 1. Wheatly
 2. Bell and Gossett
 3. Wessels
 4. Armstrong
- B. Tank: Welded steel, rated for maximum 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 1. Size: As indicated on Drawings.
- C. Bladder: Heavy duty butyl-FDA approved.

- D. Gage Glass Set: Brass compression stops, guard, and 3/4-inch red line glass, maximum 24 inches length, long enough to cover tank for two (2) inches above bottom to two (2) inches below top.
- E. Quick Connect Air Inlet:
 - 1. Expansion Tank: Inlet tire check valve, manual air vent, tank drain, and pressure relief valve.
- F. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check back flow prevention device, test cocks, strainer, vacuum breaker, and by-pass valves.
- G. Hot Water Heating System:
 - 1. Select expansion tank pressure relief valve at 20 psi maximum.
 - 2. Set pressure reduction valve at select 12 psi.
- H. Chilled Water System:
 - 1. Select expansion tank pressure relief valve at 25 psi maximum.
 - 2. Set pressure reduction valve at 12 psi.
- I. Do not insulate ASME stamp and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

2.8 AIR VENTS

- A. Manufacturers:
 - 1. Armstrong
 - 2. ITT
 - 3. Sarco
- B. Manual Type: Short vertical sections of two (2) inch diameter pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.
- C. Float Type:
 - 1. Brass, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
- D. Washer Type:
 - 1. Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring-loaded ball check valve.

2.9 COMBINATION DIRT AND AIR SEPARATORS

- A. Manufacturers:

1. Bell and Gossett
 2. Taco
 3. Armstrong
 4. Wessels
- B. Dip Tube Fitting: For 125 psig operating pressure; to prevent free air collected in boiler from rising into system.
- C. Dirt & Air Separator: Each separator must be designed with a blow-down valve, skim valve, and automatic air vent. The separator must also utilize in its design a stainless-steel coalescing medium to aid in the separation of air and dirt in the system entrained water. The separator must be constructed in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code and stamped for 125 psi working pressure.

2.10 STRAINERS

- A. Manufacturers:
1. Bell and Gossett
 2. Keckley
 3. Armstrong
 4. Mueller
- B. Size two (2) inch and Smaller:
1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32-inch stainless steel perforated screen.
- C. Size 2-1/2 inch to four (4) inch:
1. Flanged iron body for 175 psig working pressure, Y pattern with 3/64-inch stainless steel perforated screen.
- D. Size five (5) inch and Larger:
1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8-inch stainless steel perforated screen.

2.11 FLOW CONTROLS

- A. Manufacturers:
1. Bell and Gossett
 2. Nibco
 3. ITT Hoffman
- B. Construction: Ametal® Brass or bronze body, y-pattern, with union on inlet, and outlet, temperature and pressure test plug on inlet and outlet combination blow-down and back-flush drain.

- C. Calibration: Factory set to control flow within five (5) percent of design flow over entire operating pressure.
- D. Control Mechanism: Stainless steel or nickel-plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.
- E. Accessories: In-line strainer on inlet and ball valve on outlet.

2.12 RELIEF VALVES

- A. Manufacturers:
 - 1. Bell and Gossett
 - 2. McDonnell-Miller
- B. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

PART 3 - EXECUTION

3.1 INSTALLATION - THERMOMETERS AND GAGES

- A. Install pressure gages for each pump, locate taps before strainers and on suction and discharge of pump, pipe to gage.
- B. Install gage taps in piping with isolation valves.
- C. Install pressure gages with pulsation dampers. Provide needle valve or ball valve to isolate each gage. Extend nipples to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- E. Install thermometers in air duct systems on flanges.
- F. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.
- G. Locate duct-mounted thermometers minimum ten (10) feet downstream of mixing-dampers, coils, or other devices causing air turbulence.
- H. Coil and conceal excess capillary on remote element instruments.
- I. Install static pressure gages to measure across filters and filter banks, (inlet to outlet). On multiple banks, provide manifold and single gage.
- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

- L. Adjust gages and thermometers to final angle, clean windows, and lenses, and calibrate to zero.

3.2 INSTALLATION - HYDRONIC PIPING SPECIALTIES

- A. Locate test plugs adjacent to pressure gages and pressure gage taps and as indicated on Drawings.
- B. Install manual air vents at system high points.
- C. For automatic air vents in ceiling spaces or other concealed locations, install vent tubing to nearest drain.
- D. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- E. Provide drain and hose connection with valve on strainer blow down connection.
- F. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.
- G. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.
- H. Support pump fittings with floor mounted pipe and flange supports.
- I. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- J. Select system relief valve capacity greater than make-up pressure reducing valve capacity. Equipment relief valve capacity not to exceed rating of connected equipment.
- K. Pipe relief valve outlet to nearest floor drain.
- L. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

END OF SECTION 23 05 19

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Globe valves.
 - 2. Ball valves.
 - 3. Plug valves.
 - 4. Butterfly valves.
 - 5. Swing check valves.
 - 6. Spring loaded check valves.
 - 7. Flanges and unions.

1.3 SUBMITTALS

- A. Product Data: Submit Manufacturers catalog information with valve data and ratings for each service.
- B. Welders Certificate: Include welder's certification of compliance with ASME Section IX.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves.
- B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not install valves underground when bedding is wet or frozen.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer warranty for valves.

1.9 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size valve.

PART 2 - PRODUCTS

2.1 HEATING AND COOLING VALVES

A. Globe Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
 - c. Milwaukee Valve
2. Two (2) inches and Smaller: Construction: Bronze body, bronze trim, union bonnet, rising stem and hand-wheel, inside screw, renewable plug disc and stainless-steel seat ring, solder or threaded ends.
3. Two (2) inches and Larger: Construction: Iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

B. Ball Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
 - c. Belimo
 - d. Milwaukee Valve
2. Two (2) inches and Smaller: Bronze two-piece body, full port stainless steel ball and stem, Teflon seats and stuffing box ring, lever handle with balancing stops, solder or threaded ends with union.
3. Two (2) inches and Larger: Cast steel body, stainless steel ball and stem, Teflon seat and stuffing box seals, lever handle, or gear drive hand-wheel for sizes ten (10) inches and larger, flanged.
4. Where piping is insulated, ball valves shall be equipped with two (2) inch extended handles of non-thermal conductive material. Also provide a protective sleeve to prevent damage to vapor seal when valve adjustment is made. Memory stops shall be adjustable after insulation is applied.

C. Plug Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
2. Two (2) inches and Smaller: Bronze body, bronze tapered plug, full port opening, non-lubricated, Teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.
3. Two (2) inches and Larger: Cast iron body and plug, full port opening, pressure lubricated, Teflon packing, flanged ends. Furnish each plug valve with wrench with setscrew.

D. Butterfly Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
 - c. Dezurik
 - d. Haleson
 - e. Milwaukee Valve
2. Body: Cast or ductile iron with resilient replaceable EPDM seat, lug ends, extended neck.
3. Disc: Aluminum bronze.
4. Operator: 10 position lever handle on sizes two and half (2 1/2) inches to four (4) inches.
5. Hand-wheel and gear drive on sizes larger than six (6) inches.

E. Swing Check Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
 - c. Dezurik
 - d. Haleson
 - e. Milwaukee Valve
2. Two (2) and Smaller: Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder, or threaded ends.
3. Two and a half (2-1/2) inches and Larger: Iron body, bronze trim, bronze, or bronze faced rotating swing disc, renewable disc and seat, flanged ends or Ductile iron body, 316 stainless steel clapper, synthetic rubber bumper/seal and bonnet.

F. Spring Loaded Check Valves:

1. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Nibco
 - b. Crane
 - c. Dezurik
 - d. Haleson
 - e. Milwaukee Valve
2. Construction: Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer, or threaded lug ends.
3. Two (2) and Smaller: Red bronze body, 301 stainless steel spring-actuated disc, EPDM o-ring, 300 series stainless steel stem and spring, in-line, lift-type check valve.

2.2 FLANGES AND UNIONS

- A. Unions for Pipe two (2) inches and Smaller:
 1. Ferrous Piping: 150 psig malleable iron, threaded.
 2. Copper Pipe: Bronze, soldered or push-to-connect joints.
- B. Flanges for Pipe two (2) inches and Larger:
 1. Ferrous Piping: 150 psig forged steel, slip-on.
 2. Copper Piping: Bronze.
- C. Gaskets: 1/16-inch-thick preformed neoprene.
- D. Accessories: Stainless Steel bolts, nuts, and washers.
- E. Dielectric Connections:
 1. Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
 2. Waterway fitting with zinc electroplated steel or ductile iron body, threaded or plain end, water impervious isolation barrier.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Install valves with stems upright or horizontal, not inverted.
- C. Install unions downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment, or other apparatus.
- D. Install butterfly or ball shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

- E. Install calibrated-orifice, balancing valves at each branch connection to return main.
- F. Install globe or ball valves for throttling, bypass, or manual flow control services.
- G. Provide spring loaded check valves on discharge of water pumps.
- H. Provide flow controls in water re-circulating systems.
- I. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.
- J. Use 1 1/4" inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- K. Install valves in accessible locations to permit removal of bonnet.
- L. Install valve stems in vertical position. Valve stems installed in horizontal position shall be no less than 30 degrees from horizontal.

END OF SECTION 23 05 23

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Inserts.
 - 4. Flashing.
 - 5. Equipment roof curbs and support rails.
 - 6. Sleeves.
 - 7. Mechanical sleeve seals.
 - 8. Formed steel channel and angle.
 - 9. Equipment bases and supports.
 - 10. Portable roof pipe supports.
- B. Related Sections:
 - 1. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment.
 - 2. Division 7 - Thermal and Moisture Protection.

1.3 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: Show fabrication and installation details and include calculations for the following: include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
 - 4. Equipment supports.
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather, construction traffic, dirt, water, chemical, and mechanical damage.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply Firestopping materials when temperature of substrate material and ambient air is below 60 degrees Fahrenheit.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of Firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Carpenter & Paterson Inc.
 - 2. Flex-Weld, Inc.
 - 3. Globe Pipe Hanger Products Inc.
 - 4. Michigan Hanger Co.
 - 5. B-Line Systems
 - 6. Carpenter & Patterson Inc.
 - 7. Anvil International
 - 8. Piping Technology & Products
 - 9. Grinnell
- B. Hydronic Piping:
 - 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.

2. Hangers for Cold Pipe Sizes two (2) inches and larger: Carbon steel, adjustable, clevis.
 3. Hangers for Hot Pipe Sizes 2 inches to 4 inches: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes six (6) inches and larger: Adjustable steel yoke, cast iron roll, double hanger.
 5. Multiple or Trapeze Hangers: Galvanized Steel channels with welded spacers and hanger rods.
 6. Multiple or Trapeze Hangers for Hot Pipe Sizes six (6) inches and larger: Galvanized Steel channels with welded spacers and hanger rods, cast iron rollers.
 7. Wall Support for Pipe Sizes three (3) inches and smaller: Cast iron hooks.
 8. Wall Support for Pipe Sizes four (4) inches and larger: Welded galvanized steel bracket and wrought steel clamp.
 9. Wall Support for Hot Pipe Sizes six (6) inches and larger: Welded galvanized steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron roll.
 10. Vertical Support: galvanized Steel riser clamp.
 11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 12. Floor Support for Hot Pipe Sizes four (4) Inches and smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes six (6) inches and larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 14. Copper Pipe Support: Copper-plated, carbon steel ring.
 15. Hydronic Piping shall not have support brackets welded to hydronic piping.
- C. Roof Mounted Hydronic Piping:
1. Refer to Division 7 –for hanger requirements and approved manufacturers.

2.2 HANGER RODS

- A. Hanger Rods: Hot dipped galvanized, mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

- A. In accordance with Division 7 - Thermal and Moisture Protection.

2.5 HOODED CURB

- A. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24-gauge stainless steel.

2.6 EQUIPMENT ROOF CURBS AND SUPPORT RAILS

- A. Equipment roof curbs and support rails must be coordinated with roof type specified under Division 7.
- B. Roof mounted exhaust fans, intake hoods, relief hoods and supply fans shall be set on equipment manufacturers 12" high fabricated welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick curb insulation, factory installed treated wood nailer. Curb shall set level on roof without the need for blocking.
- C. Roof mounted unitary air conditioning units shall be set on a structural type of curb or equipment support rail. Curb or support rail shall be compatible with required vibration isolation specified under Section 23 05 48. Curb or support rail shall be 12" high welded 18-gauge galvanized steel shell and base, mitered three (3) inch cant if required by roofing type, variable step to match roof insulation, 1-1/2-inch-thick insulation, 3 lb. density, factory installed wood nailer and stainless-steel cap. Curb shall set level on roof without the need for blocking. Field bolted curbs are not acceptable.
- D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. The Pate Co.
 - b. Custom Curb, Inc.
 - c. Roof Products, Inc.
- E. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

2.7 SLEEVES

- A. Sleeves for Pipes through fire rated or non-fire rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes through Rated or Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sleeves for Rectangular Ductwork: Galvanized steel.
- E. Sealant: Refer to Section 07 92 00 - Building Sealants.

2.8 MECHANICAL SLEEVE SEALS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation

- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.9 FORMED STEEL CHANNEL AND ANGLE

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.

- B. Product Description: Galvanized 14 gage thick steel angle and galvanized 12 gage thick steel channel with holes 1-1/2 inches on center. Metal framing system for equipment support.

- C. All channel members and angles shall be hot-dipped galvanized and fabricated from structural grade steel and conform to applicable ASTM specifications.

- D. Structural members to be loaded within manufacturers design limitations and published data.

2.10 EQUIPMENT BASES AND SUPPORTS

- A. In accordance with Division 3 – Concrete

- B. Provide concrete equipment pads, reinforced with 6-inch x 6-inch welded wire mesh, chamfered edges and to be six (6) inches larger than base of equipment. Pad heights as follows:
 - 1. Hot Water Boilers: four (4) inches.
 - 2. Floor Mounted Pumps: four (4) inches.
 - 3. Floor Mounted Water Volume Tanks: four (4) inches.
 - 4. Air Handling Units: four (4) inches.
 - 5. Water Heaters: four (4) inches.
 - 6. Water Softeners: four (4) inches.
 - 7. Air Compressor: four (4) inches.
 - 8. Floor Mounted Expansion Tanks: four (4) inches.
 - 9. Floor Mounted chemical feeder tanks: four (4) inches.
 - 10. Floor Mounted Fans: four (4) inches.
 - 11. Chillers: four (4) inches.
 - 12. Condensing Units: four (4) inches.
 - 13. Heat Pump Units: four (4) inches.
 - 14. Dust Collectors: four (4) inches.
 - 15. Plasma cutters: four (4) inches.

- C. Provide vibration isolation in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

2.11 PORTABLE ROOF PIPE SUPPORTS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Advanced Support Products (ASP)
 2. Miro Industries, Inc.
- B. Steel and PVC Piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel, 4'-0" maximum intervals for PVC piping. Roof supports shall be manufactured by Advanced Support Products (ASP), model SS6000P with height adjustable crossbar and clevis hangers. Product specifications:
1. Support Base: 17" circular base, injected molded polypropylene, with 227 sq. in. of surface on bottom, designed for weight displacement.
 2. Base Dimensions: 3"H x 17" in diameter, designed for weight displacement, with molded insert for square tubing and two threaded rod couplings molded in.
 3. Height: Adjustable.
 4. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.
 5. Hardware: Corner brackets and leg brackets bolted with 1/2" x 2-1/2" bolt & 1/2" nut; frame bolted to support base with 1/2" x 2-1/2" bolts, 1/2" nuts and washers. Leg brackets and all thread rods, nuts and washers shall be hot- dipped galvanized.
 6. Required accessories: 1/2" threaded rod, clevis hangers, strut clamps and protection pads.
- C. Condensate disposal piping: Provide rooftop portable pipe supports in 8'-0" maximum intervals for steel condensate piping. Roof supports shall be manufactured by Advanced Support Products (ASP), model REC-SA (Rubber EcoCurb) with channel. Product specifications:
1. Bases: 100% recycled Vulcanized Rubber with UV inhibitors.
 2. Frame: 1-5/8" x 1-5/8" 12-gauge channel (ASTM A653), hot- dipped galvanized.
 3. Hardware: 1/2" threaded rods (12" high); 1/2" nuts & washers, hot- dipped galvanized.
 4. Height: Adjustable.
 5. Required accessories: Strut clamps and protection pads.
 6. Hot dipped galvanized threaded rods, nuts and washers.
- D. Protection pads: Provide protection pad sheets between the roof / grade and support system. Protection pads shall not be adhered to either the roof or the support system.

1. Material: Porous rubber.
2. Weight: 2 lbs.
3. Dimensions: 18" square X ½" thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive Firestopping/Firesafing.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of Firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Do not drill or cut structural members.
- F. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 STRUCTURAL STEEL

- A. All structural steel used to fabricate supports shall conform to ASTM A36.

3.4 CUTTING AND PATCHING

- A. In accordance with Division 7 - Thermal and Moisture Protection

3.5 FIRESTOPPING

- A. In accordance with Division 7 - Thermal and Moisture Protection.

3.6 FIRESTOPPING ACCESSORIES

- A. In accordance with Division 7 - Thermal and Moisture Protection.

3.7 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe four (4) inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.8 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2-inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2-inch minimum vertical adjustment.
- F. Support vertical piping at every other floor.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports.
- L. Provide clearance in hangers and from structure and other equipment for installation of pipe insulation. Refer to Section 23 07 19 - HVAC Piping Insulation.

3.9 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum four (4) inches thick and extending six (6) inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.10 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide curbs for mechanical roof installations 12 inches minimum above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- C. Adjust storm collars tight to pipe with bolts, caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

- D. Refer to Division 7 - Thermal and Moisture Protection for additional requirements.

3.11 INSTALLATION - SLEEVES

- A. Provide sleeves at all piping and ductwork penetrations of interior walls and slabs. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors two (2) inches above finished floor level. Caulk sleeves.
- E. Extend sleeves through walls two (2) inches each side.
- F. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with Firestopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

3.12 INSTALLATION - FIRESTOPPING

- A. Install material at all fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items.
- B. Apply primer where recommended by manufacturer for type of Firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply Firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Fire Rated Surface:
 - 1. Seal opening at floor, wall, and partition as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- F. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall and partition floor as follows:

- a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
2. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 4. Interior partitions: Seal pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.13 INSTALLATION - ACCESS DOORS

- A. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts, and other apparatus where concealed. Access doors shall have concealed hinges and screwdriver cam locks. Minimum size to be 12 inches x 12 inches in walls only for hand access and 24 inches x 24 inches minimum for all ceilings for maintenance access.
- B. All access doors located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.
- C. Access Doors:
 1. Plastic Surfaces: Milcor Style K.
 2. Ceramic Tile Surface: Milcor Style M.
 3. Drywall Surfaces: Milcor Style DW.
 4. Install panels only in locations approved by the Architect and with trim styles and color coordinated with surface to be installed in.

3.14 INSTALLATION – EQUIPMENT REQUIRING ROOF PORTALBE BASES

- A. Verify that roof surface is smooth and clean to extent needed to receive material.
- B. Clean surfaces to receive 17” circular bases removing any loose gravel and foreign matter before setting 17” circular bases.
- C. Provide protective pad conforming to the new or existing roof manufacturer’s system under each 17” circular bases. Do not adhere to the roof system or to circular bases.

3.15 FIELD QUALITY CONTROL

- A. Inspect installed Firestopping for compliance with specifications and submitted schedule.

3.16 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.17 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.18 PIPE HANGERS

- A. Minimum hanger rod size shall be ½”.
- B. Maximum hanger rod spacing shall not exceed 10'-0” on center for pipe sizes 2” and above. Do not exceed 7'-0” hanger spacing for pipes sizes less than 2” diameter.
- C. For trapeze supports provide a minimum of (2) two ½” hanger rods at each end of trapeze for a total of (4) four for pipes 10” or larger.
- D. Beam clamps are not acceptable.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Vibration isolation for building mechanical systems.
- B. Related Sections:
 - 1. Section - 23 05 16 - Expansion Fittings and Loops For HVAC Piping
 - 2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- C. Mason Industries model numbers are listed for identification only.
- D. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Mason Industries
 - 2. Kinetics Noise Control
 - 3. Amber / Booth
 - 4. VMC
 - 5. Vibration Eliminator

1.3 PERFORMANCE REQUIREMENTS

- A. It is the intent of this specification to provide vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure. It will be the Contractor's responsibility to select and install vibration isolators which will enable the noise criteria standards to be met, to the extent that the noise can be controlled by the vibration isolators.
- B. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or supplier.
- C. Unless otherwise noted or scheduled, spring type vibration isolators shall be used for all equipment driven by motors of 0.5 HP and larger. Deflections as tabulated are minimums and it shall be the responsibility of the isolation manufacturer to determine the amount of spring deflection required for each isolator to achieve optimum performance in order to prevent the transmission of objectionable vibrations and meet the noise criteria referenced herein.
- D. Unless otherwise noted, equipment driven by motors 0.25 HP and smaller shall be isolated by means of Type ND elastomeric mounts or Type HD elastomeric hangers properly sized for 0.35-inch deflection.
- E. All elastomeric isolators shall be of high-quality synthetic rubber with anti-ozone and anti-oxidant additives.

- F. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with epoxy powder paint coating. Components exposed to the weather shall be epoxy powder paint coated or hot-dipped galvanized. Furnish zinc electroplated nuts, bolts, and washers. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.
- G. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind loads of 30 lbs/sq.ft. Wind loading shall be applied to all exposed surface of the isolated equipment in order to identify worst case load.
- H. Air handling equipment subjected to excessive horizontal air thrust operating at three (3) inches S.P. shall be furnished with Type WBI/WBD isolated thrust resisters to limit displacement to 1/4 inch.
- I. Height savings brackets used with isolators having 2.5-inch deflection or greater shall be of the precompression type to limit exposed bolt length.
- J. All spring isolators shall be completely stable in operation and shall be designed for not less than 50 percent reserve deflection beyond actual operating conditions. All spring isolators must be completely stable in operation and have a Kx/Ky ratio of at least 1:1.
- K. All isolation materials and flexible connectors shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor at no additional cost to the Owner. Manufacturer may purchase other manufactured products in order to meet this specification and shall guarantee outsourced product as a single point of responsibility. Outsourced products must be identified as such in the submittal for approval.
- L. The contractor and manufacturer of the isolation and equipment shall refer to the isolator schedule which lists isolator types and isolator deflections.
- M. Deflection table is based on maintaining rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE and ANSI S1.8.
 - 1. Offices
Executive: 30
Conference rooms: 30
Private: 35
Open-plan areas: 35
Computer/business machine areas: 40
Public circulation: 40
 - 2. Schools
Lecture and classrooms: 30
Open-plan classrooms: 35
 - 3. Libraries: 25
 - 4. Theaters
Theater: 25
Stage house: 25
Trap room: 25
Orchestra pit: 25
Rehearsal rooms: 25

Teaching studios: 30
Practice rooms: 30
Ensemble rooms: 30
Shop: 45

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, and layout as well as connection details.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating materials and dimensional data. All steel bases and concrete inertia bases shall be completely detailed. Include clearly outlined procedures for installing and adjusting the isolators.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate vibration isolation installation is complete and in accordance with instructions. Provide a copy of field report to Architect/Engineer.

1.5 QUALITY ASSURANCE

- A. The vibration isolation manufacturer, or qualified representative, shall be responsible for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Vibration isolation manufacturer shall also inspect vibration isolation in units with factory provided isolation in order to confirm scheduled deflection and isolator type is in accordance with this specification. Upon completion of the installation and after the system is put into operation, the manufacturer, or representative, shall make a final inspection and submit his report to the Architect and Engineer in writing certifying the correctness of installation and compliance is in accordance approved submittal data.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATOR TYPES

All vibration isolators described in this section shall be the product of a single manufacturer. Submittals and certification sheets shall be in accordance with Specification 1.3 of this section.

- A. Type WSW: Two layers of 3/8-inch thick neoprene pad consisting of square waffle modules separated horizontally by a 16-gauge galvanized shim. Where the load bearing area of the equipment is not the same size/shape as the load bearing area/shape of the

pad, load distribution plates, minimum ¼” thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized. Pads shall be sized for approximate deflection of 0.12 inch to 0.16 inch.

- B. Type ND: Neoprene mountings shall have minimum static deflection of 0.35 inch. All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes on the bottom and a tapped hole with a mounting bolt and washer shall be provided. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Where the load bearing area of the equipment or support structure is not the same size/shape as the load bearing area/shape of the pad, load distribution plates, minimum ¼” thick galvanized steel, shall be utilized to ensure the load bearing capacity of the pad is maximized.
- C. Type SLF: Spring isolators shall be free-standing and laterally stable without any housing and complete with a steel-washer-reinforced molded neoprene cup of 1/4-inch neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have minimum additional travel to solid equal to 50 percent of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.
- D. Type SLR: Restrained spring mountings shall have an SLF mounting as described in Specification 2.1 C, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position under outdoor equipment, there must be an internal isolation pad in addition to the friction pad on bottom.
- E. Type HD: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene element. The neoprene element shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers.
- F. Type 30N: Hangers shall consist of rigid steel frames containing minimum 1-1/4-inch-thick neoprene elements at the top and a steel spring as described in 2.1 C, seated in a steel-washer-reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. In order to maintain stability, the boxes shall not be articulated as clevis hangers, nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30-degree capability.
- G. Type PC30N: Hangers shall be as described in Specification 2.1 F, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic up stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30-degree capability.

- H. Type WBI/WBD: Horizontal thrust restraints shall consist of a spring element in series with a neoprene molded cup, as described in paragraph 2.1 C, with the same deflection as specified for the mountings or hangers supporting the unit. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4-inch movement at start and stop. The assembly shall be furnished with a rod and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit.
- I. Type SLR-MT: Restrained air spring mountings shall be manufactured with upper and lower steel sections connected by a replaceable flexible DuPont Kevlar reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. Restrained air springs shall be within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/2 inch {12mm} shall be maintained around restraining bolts and between the housing and the air springs so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Air spring systems shall be connected to a supplementary air supply compressor (supplied with the air spring system) through a Mason Industries air spring control panel and equipped with three leveling valves to maintain level within plus or minus 0.125". Air spring mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician.

2.3 FLEXIBLE PIPE CONNECTIONS (CHILLERS AND BASE-MOUNTED PUMPS)

- A. Type SFDEJ, SFEJ, SFDCR or SFU with Control Rods CR (required): Flanged and threaded rubber flexible joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1-1/2" through 14" shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" may be single sphere. Sizes 3/4" through 2" may have one sphere, bolted threaded flange assemblies and cable retention. Minimum ratings through 14" shall be 250psi at 170°F and 215psi at 250°F, 16" through 24" 180psi at 170°F and 150psi at 250°F. Higher published rated connectors may be used where required. Safety factors shall be a minimum of 3/1. All flexible joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment. The piping gap shall be equal to the length of the flexible joint under pressure. Control rods passing through 1/2" thick Neoprene washer bushings large enough to take the thrust at 1000psi of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the flexible joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- B. Isolators shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 0.5 hp and over per the isolation schedule and these specifications.

3.2 PIPING ISOLATION

- A. Horizontal Pipe Isolation: All pumped water, pumped condensate, and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50 feet or 100 pipe diameters from externally isolated equipment. For the first 3 support locations from externally isolated equipment provide Type 30N hangers or Type SLF floor mounts with the same deflection as equipment isolators. All other piping within the equipment rooms shall be isolated with the same specification isolators with a 1" inch minimum deflection. Install piping hangers at regular intervals according to the pipe hanger schedule. Where floor supports are required, provide sufficient spring capacity to absorb expansion and contraction of piping, and yet to permit piping to function as a floating system. Size hangers for 200 percent rated load. Coordinate selection of piping supports with equipment supports to accommodate expansion and contraction without creating excessive stresses at equipment connections.
- B. Pipe Riser Isolation: All vertical pipe risers 1-1/4 inch and larger, where specifically shown and detailed on riser drawings shall be fully supported by Type SW SLF isolators with brackets. Refer to details on Drawings. Steel spring deflection shall be 3/4 inch minimum. In locations where added deflection is required due to pipe expansion/contraction, the spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Provide Type SWS wall sleeves. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the piping system has been examined for excessive stresses and that none will exist in the design proposed.

3.3 INSTALLATION

- A. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.
- B. Locate isolation hangers as near the overhead support structure as possible.
- C. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- D. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one (1) inch clearance below base will result when supported equipment has been installed and loaded for operation.
- E. Install Work in accordance with ASME B31.9.
- F. Install flexible pipe connectors to equipment supported by vibration isolation. Provide line size flexible connectors.
- G. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.
- H. Refer to Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.

- I. Contractor shall install load distribution plates provided by vibration isolation manufacturer on WSW type isolators. Plates shall be aligned with isolation pad.

EQUIPMENT ISOLATION SCHEDULE						
EQUIPMENT	LOCATION					
	ELEVATED STRUCTURE			SLAB ON GRADE		
	ISOLAT OR TYPE	MINIMUM DEFLECT ION (Inches)	BASE (1) TYPE	ISOLAT OR TYPE	MINIMUM DEFLECT ION (Inches)	BASE (1) TYPE
AIR HANDLING UNITS (NOTE 2)						
FLOOR MOUNTED	SLF	0.75	-	SLF	0.75	-
TO 15 HP	SLF	1.5	-	SLF	0.75	-
20 HP & OVER						
SUSPENDED	30N	1	-	30N	1	-
UP TO 15 HP	PC30N	1.75	-	PC30N	1	-
20 HP & OVER						
HIGH PRESSURE FAN SECTION (NOTE 1)	SLF/W	1.5	RBMK	SLF/W	0.75	RBMK
UP TO 30 HP	BI	2.5	RBMK	BI	1.5	RBMK
40 HP & OVER	SLF/W			SLF/W		
BI				BI		
CENTRIFUGAL FANS						
CL. I & II UP TO 54-1/2" W.D.						
Up to 15 HP	SLF	0.75	WF	SLF	0.75	WF
20-50 HP	SLF	1.5	RBMK	SLF	0.75	WF
60 HP & OVER	SLF	2.5	RBMK	SLF	1.5	WF
CL. I & II 60" W.D. & OVER/ALL						
CL. III FANS UP TO 15 HP	SLF/W	1.5	RBMK	SLF/W	0.75	RBMK
20-50 HP	BI	2.5	RBMK	BI	1.5	RBMK
60 HP & OVER	SLF/W	2.5	RBMK	SLF/W	1.5	RBMK
BI				BI		
SLF/W				SLF/W		
BI				BI		
AXIAL-FLOW FANS (NOTE 1)						
FLOOR MTD.						
UP TO 15 HP	SLF	0.75	-	SLF	0.75	-
20 HP & OVER	SLF	1.5	-	SLF	0.75	-
SUSPENDED (NOTE 1)						
UP TO 15 HP	30N	1	-	30N	1	-
20 HP & OVER	PC30N	1.75	WF	PC30N	1.5	-
VENT (UTILITY SETS)						
FLOOR MTD.	SLF	0.75	-	SLF	0.75	-
SUSPENDED	30N	1	-	30N	0.75	-
CABINET FANS, FAN SECTIONS (NOTE 1)						
CL. I & II UP TO 54-1/2" W.D.						
Up to 15 HP	SLF	0.75	-	SLF	0.75	-
20-50 HP	SLF	1.5	-	SLF	0.75	-
SUSPENDED						
UP TO 15 HP	30N	1	-	30N	0.75	-
	PC30N	1.75	-	30N	1.75	-

20 HP & OVER						
PUMPS						
FLOOR MTD. UP TO 60 HP	SLF	1.50	RBMK	SLF	0.75	RBMK
FLOOR MTD. 75 HP AND LARGER	SLF	2.50	RBMK	SLF	0.75	RBMK
SUSPENDED INLINE	PC30N	1.75	-	PC30N	1.75	-
REFRIGERATION UNITS						
RECIPROCATING COMPRESSORS	SLF	1.5	RBMK	SLF	0.75	RBMK
RECIPROCATING COND. UNITS & CHILLERS	SLR/IC	1.5	-	SLF	0.75	-
HERMETIC	S	1.5	-	WSW	0.15	-
CENTRIFUGALS	SLR	1.5	RBMK	WSW	0.15	-
OPEN CENTRIFUGALS	SLF	0.75	-	WSW	0.15	-
ABSORPTION MACHINES	SLR/IC					
	S					
AIR COMPRESSORS						
TANK TYPE (HORIZONTAL TANK)	SLF	1.5	-	SLF	0.75	-
TANK TYPE (VERTICAL TANK)	SLF	1.5	-	SLF	0.75	-
COOLING TOWERS & CLOSED-CIRCUIT COOLERS						
UP TO 500 TONS	SLR	0.75	(1)	WSW	0.15	-
OVER 500 TONS	SLR	2.5	(1)	WSW	0.15	-
AIR COOLED CONDENSERS						
UP TO 50 TONS	SLR	0.75	(1)	WSW	0.15	-
OVER 50 TONS	SLR	1.5	(1)	WSW	0.15	-
ROOFTOP AIR CONDITIONING UNITS						
REQUIRING WEATHER SEAL	SLF	0.75	RSC/C	-	-	-
UP TO 5000 CFM (12 TON)	SLR	1.5	MAB	-	-	-
OVER 5000 CFM (12 TON)			RSC/C			
OTHER TYPES	SLR	1.5	MAB	-	-	-
UP TO 25 TONS	SLR	1.5		-	-	-
OVER 25 TONS			(1)			
			(1)			
BOILER (PACKAGE TYPE)						
ALL SIZES	SLR	0.75		WSW	0.15	-
ENGINE DRIVEN GENERATORS						
UP TO 60 HP	SLR	1.5	RBMK	SLR	0.75	-
75 HP & OVER	SLR	2.5	RBMK	SLR	0.75	-

Notes:

1. Provide steel base type WF if equipment requires base frame or does not include integral base rail for vibration isolation.
2. Provide WSW isolator type with load distribution plate for floor mounted AHU's that are internally isolated. Isolation deflection and type specified refers to factory isolation requirements.

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
 - 4. Pipe markers.
 - 5. Ceiling tacks.
 - 6. Labels.
 - 7. Lockout devices.
 - 8. Pipe painting (if required)
- B. Related Sections:
 - 1. Section 09 91 00 - Painting and Staining.
- C. Color scheme for identification must be coordinated with district standards. Color scheme specified is bases of design if required for project. Contractor shall confirm painting requirements with Architect/District.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.
 - 2. District Standards for identification and color scheme.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Identify painting requirements as directed by Architect/District. Contractor to confirm if painting of piping is required for project. Contractor shall provide primer coat on un-insulated outdoor condenser water piping as a minimum.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Conform to ANSI / OSHA Pipe Marking Specifications.
- C. Specification is not limited to manufacturers listed. Substitutions are allowed in accordance with Division 1 - General Requirements and Division 23, Section 23 05 00 - Common Work Results for HVAC.

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Craftmark Identification Systems.
 - 2. Safety Sign Co.
 - 3. Seton Identification Products.
 - 4. Almetek Industries.
 - 5. Marking Services, INC. (MSI).
- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

- A. Plastic Tags:
 - 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - 2. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches.
- B. Metal Tags:

1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.
- C. Information Tags:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- D. Tag Chart: Typewritten letter size list of applied tags and location in plastic laminated chart to indicate valve make, size, model, and service.

2.3 STENCILS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Craftmark Identification Systems.
 2. Safety Sign Co.
 3. Seton Identification Products.
 4. Almetek Industries.
 5. Marking Services, INC. (MSI).
- B. Stencils: With clean cut symbols and letters of following size:
1. Up to two (2) inches Outside Diameter of Insulation or Pipe: 1/2-inch-high letters.
 2. 2-1/2 to six (6) inches Outside Diameter of Insulation or Pipe: one (1) inch high letters.
 3. Over six (6) inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
 4. Ductwork and Equipment: 1-3/4 inches high letters.
- C. Stencil Paint: As specified in Section 09 91 00 Paintings and Staining, semi-gloss enamel, colors, and lettering size in conformance with ASME A13.1.

2.4 PIPE MARKERS

- A. Plastic Pipe Markers:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- B. Plastic Tape Pipe Markers:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- C. Plastic Underground Pipe Markers:
1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 2. Bright colored continuously printed plastic ribbon tape, minimum six (6) inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
1. Craftmark Identification Systems.
 2. Safety Sign Co.
 3. Seton Identification Products.
 4. Almetek Industries.
 5. Marking Services, INC. (MSI).
- B. Description: Steel with 3/4-inch diameter color-coded head.

2.6 LABELS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Craftmark Identification Systems.
 - 2. Safety Sign Co.
 - 3. Seton Identification Products.
 - 4. Almetek Industries.
 - 5. Marking Services, INC. (MSI).
- B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification and bar code.

2.7 LOCKOUT DEVICES

- A. Lockout Hasps:
 - 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - 2. Reinforced nylon hasp with erasable label surface; size minimum 7-1/4 x 3 inches.
- B. Valve Lockout Devices:
 - 1. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - a. Craftmark Identification Systems.
 - b. Safety Sign Co.
 - c. Seton Identification Products.
 - d. Almetek Industries.
 - e. Marking Services, INC. (MSI).
 - 2. Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 91 00 Paintings and Staining for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with Section 09 91 00 Paintings and Staining.

- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain or 4 ply 0.018 smooth copper wire. Tags shall be numerically sequenced with all valves of each system type grouped together.
- F. Install underground plastic pipe markers six (6) to eight (8) inches below finished grade, directly above buried pipe.
- G. All exterior visible piping shall be identified with UV and acid resistant outdoor pipe markers.
- H. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.
- I. Identify control panels and major control components outside panels with plastic nameplates.
- J. Identify air terminal units and radiator valves with numbered tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify insulated piping, concealed, or exposed indoor with plastic tape pipe markers. Use tags on piping 3/4-inch diameter and smaller. Use plastic pipe UV protected markers on exterior piping. Identify service and flow direction. Install in clear view and align with axis of piping. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.
- M. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Coordinate with Architect.
- N. Identify un-insulated piping with plastic pipe markers. Locate identification at every 20 feet on center for straight runs including risers and drops. Locate identification adjacent to each valve and tee, at each side of penetration of wall or enclosure, and at each obstruction.

3.3 IDENTIFICATION SCHEDULE

- A. Markers shall be colored as indicated below per ANSI/OSHA Standards OR as specified in District Standards:

SYSTEM	COLOR	LEGEND
Chilled Water	Green	Chilled Water Supply Chilled Water Return
Domestic Water	Green	Domestic Water
Domestic Hot Water Supply	Yellow	Domestic Hot Water Supply

Domestic Hot Water Return	Yellow	Domestic Hot Water Return
Fire Protection	Red	Fire Protection
Automatic Sprinkler	Red	Fire Sprinkler
Gas	Yellow	Natural Gas
Condenser Water	Green	Condenser Water Supply
		Condenser Water Return

B. PIPE PAINTING:

1. All piping exposed to view in conditioned spaces shall be painted as indicated or as directed by the Architect in the field. Confirm all color selections and painting requirements with Architect/District prior to installation.
2. The entire fire protection piping system shall be painted red.
3. All outdoor un-insulated piping shall be painted with primer as a minimum.
4. All piping located in mechanical rooms and outdoor piping shall be painted as indicated in Painting Schedule. Painting requirement must be confirmed by contractor.

C. PAINTING SCHEDULE

SYSTEM	COLOR
Storm Sewer	White
Sanitary Sewer Waste and Vent	Light Gray
Domestic Cold Water	Dark Blue
Domestic Hot Water Supply and Return	Orange
Condenser Water Supply and Return	Light Green
Gas	Yellow
Chilled Water Supply and Return	Light Blue
Heating Hot Water supply and Return	Reddish Orange

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Testing, adjusting, and balancing of air systems.
 - 2. Testing, adjusting, and balancing of Hydronic piping systems.
 - 3. Testing, adjusting, and balancing of refrigerating systems.
 - 4. Measurement of final operating condition of HVAC systems.
 - 5. Sound measurement of equipment operating conditions.
 - 6. Vibration measurement of equipment operating conditions.
- B. Related Sections:
 - 1. Sequences of operation for HVAC equipment as scheduled on Drawings.
- C. Testing, Adjusting and Balancing (TAB) contractor shall bid work specified under this section direct to Owner. TAB contractor shall not be hired by general contractor or any sub-contractor.
- D. Mechanical contractor is responsible for coordinating work with the TAB Contractor. Mechanical contractor requirements are specified herein.

1.3 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.4 SUBMITTALS

- A. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.

- B. Engineer and Technicians Data: Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- C. Procedures and Agenda: Submit a synopsis of the testing, adjusting and balancing procedures and agenda proposed to be used for this project.
- D. Sample Forms: Submit sample forms, if other than those standard forms, if other than those standard forms prepared by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) are proposed.
- E. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
 - 1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit two (2) complete sets of draft reports. Only one (1) complete set of draft reports will be returned.
 - 2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit two (2) complete sets of final reports.
 - 3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binder. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs.
 - a. General Information and Summary
 - b. Air Systems
 - c. Refrigerant Systems
 - d. Temperature Control Systems
 - e. Special Systems.
 - 4. Report Contents: Provide the following minimum information, forms and data:
 - a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, the Company, Engineer, and Project. Include addresses and contact names and telephone numbers. Also include a certification sheet containing the seal name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

- b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six (6) months prior to starting the project.

1.5 QUALITY ASSURANCE

- A. Test and Balance Engineer's Qualifications: A Professional Engineers registered in the State in which the services are to be performed and having at least three (3) years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.
- B. Agency Qualifications:
 - 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to the test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and recording and reporting the results.
 - 2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or by the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.
- C. Codes and Standards
 - 1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
 - 2. AABC: "National Standards for Total System Balance."
 - 3. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) ASHRAE Handbook, 1999 HVAC Applications Volume, Chapter 36, Testing, Adjusting, and Balancing.
- D. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct a conference with the Engineer and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of the system operation and readiness for testing, adjusting, and balancing.

1.6 PROJECT CONDITIONS

- A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.7 SEQUENCING AND SCHEDULING

- A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within five (5) degrees Fahrenheit wet bulb temperature of maximum summer design condition, and within ten (10) degrees Fahrenheit dry bulb temperature of minimum winter design condition. Take final temperature reading during seasonal operation.
- C. Notice: Provide minimum 7 days advanced notice for each test. Include scheduled test dates and times.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 SERVICES OF THE MECHANICAL CONTRACTOR

- A. Examine the contract documents to become familiar with Project requirements and to discover conditions in systems design that may preclude proper TAB of systems and equipment.
- B. Examine the approved submittals for HVAC systems and equipment.
- C. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed, and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place or in normal position.
 - 15. Service and balancing valves are open.
 - 16. Re-sheave
- D. Contractor shall provide all volume dampers, balancing dampers, balancing valves, test ports and Pete's plugs as required by the Testing and Balancing Firm. Contractor shall furnish a set of sheet metal shop drawings and HVAC piping drawings to the Testing and

Balancing Firm during the submittal phase and incorporate the Testing and Balancing Firm's mark-ups and requests into the project. Contractor shall provide all required equipment to facilitate Testing and Balancing Firm's work. This coordination shall be included in the Contractor's base bid price.

- E. Provide, correct, repair or replace deficient items or conditions found during the testing and balancing.
- F. Provide replacement sheaves as directed by TAB Contractor to achieve scheduled air volumes.
- G. For motors with a variable frequency drive, contractor shall provide belt and sheave adjustment such that units deliver their design cfm when speed drive is at 60 hertz.

3.2 SERVICES OF THE TESTING AND BALANCING CONTRACTOR

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- C. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 INSTALLATION TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust fans and Equipment with Fans: +/- 5%
 - 2. Air Outlets and Inlets: +/- 5%
 - 3. Heating-Water Flow Rate: +/- 5%
 - 4. Cooling-Water Flow Rate: +/- 5%

3.4 ADJUSTING

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross-sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries in clean rooms.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from construction manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

- C. Measure air outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS

- A. Verify that the cooling coil is capable of full-system airflow and set mixing boxes at full-cold airflow position for fan volume.
- B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
 - 1. If insufficient static pressure exists, increase airflow at the fan.
- C. Test and adjust the constant-volume mixing boxes as follows:
 - 1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
 - 2. Verify sufficient inlet static pressure before making volume adjustments.
 - 3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.
- D. Do not over pressurize ducts.
- E. Re-measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
- F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. **Compensating for Diversity:** When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - b. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan if one is installed and verify operation of the static-pressure controller.

6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure static pressure at the sensor.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.9 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Set unit at maximum airflow through the cooling coil.
- B. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Owner/Engineer and comply with requirements in "Hydronic Pump Specification."
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 10 percent of design.

- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated pre-settings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.14 PROCEDURES FOR DOMESTIC HOT WATER SYSTEMS

- A. The test and balance contractor shall provide testing, adjusting and balancing of the hot water system, once the system is fully installed and operational. Preliminary and final reports shall be prepared and issued to the General Contractor, Architect and Engineer.
- B. Preparation of the hot water system for balancing:
 - 1. Confirm outlet temperature of the system at water heaters and/or storage tanks.

2. Verify recirculation pump operation and rotation.
 3. Confirm/adjust setpoint of each individual riser balancing valve to flow a minimum of 0.5 gpm or as otherwise noted on the documents.
- C. The test and balance report shall indicate the following:
1. Pressure, temperature and flow in gpm at the discharge side of each balancing valve referencing the valve tag number.
 2. Pressure, temperature and flow in gpm at the suction side of each circulating pump.

3.15 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

3.16 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.17 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.

2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
6. Capacity: Calculate in tons of cooling.
7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.18 PROCEDURES FOR COOLING TOWERS

- A. A complete Factory CTI certified test of the cooling tower will be performed at the expense of the cooling tower manufacturer. A copy of this test (provided by others) shall be included in the final TAB report. Balance the flow over and through bypass connections of the tower.

3.19 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.20 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.21 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the refrigerant charge.
 4. Check the condition of filters.
 5. Check the condition of coils.

6. Check the operation of the drain pan and condensate-drain trap.
 7. Check bearings and other lubricated parts for proper lubrication.
 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.
 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 4. Balance each air outlet.

3.22 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and product data.

- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.

- d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).
 - f. Preheat-coil static-pressure differential in inches wg (Pa).
 - g. Cooling-coil static-pressure differential in inches wg (Pa).
 - h. Heating-coil static-pressure differential in inches wg (Pa).
 - i. Outdoor airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.
- F. Apparatus-Coil Test Reports:
 1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft
 - h. Tube size in NPS (DN).
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm (L/s).
 - b. Average face velocity in fpm (m/s).
 - c. Air pressure drop in inches wg (Pa).

- d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
 - e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
 - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
 - h. Water flow rate in gpm (L/s).
 - i. Water pressure differential in feet of head or psig (kPa).
 - j. Entering-water temperature in deg F (deg C).
 - k. Leaving-water temperature in deg F (deg C).
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig (kPa).
 - n. Refrigerant suction temperature in deg F (deg C).
 - o. Inlet steam pressure in psig (kPa).
- G. Gas Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h (kW).
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.
 - n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg (Pa).
 - f. Leaving-air static pressure in inches wg (Pa).
 - g. Air static-pressure differential in inches wg (Pa).
 - h. Low-fire fuel input in Btu/h (kW).
 - i. High-fire fuel input in Btu/h (kW).
 - j. Manifold pressure in psig (kPa).
 - k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h (kW).
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h (kW).
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm.
 - i. Face area in sq. ft.
 - j. Minimum face velocity in fpm.
 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h (kW).
 - b. Air flow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).

- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig (Pa).
- K. Air-Terminal-Device Reports:
1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm (L/s).
 - b. Entering-water temperature in deg F.

- c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig (kPa).
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.

- M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig (kPa).
 - h. Required net positive suction head in feet of head or psig (kPa).
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.

 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig (kPa).
 - b. Pump shutoff pressure in feet of head or psig (kPa).
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig (kPa).
 - f. Final discharge pressure in feet of head or psig (kPa).
 - g. Final suction pressure in feet of head or psig (kPa).
 - h. Final total pressure in feet of head or psig (kPa).
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.

- N. Vibration Test:
 1. Location of points:
 - a. Fan bearing, drive end
 - b. Fan bearing, opposite end
 - c. Motor bearing, center (when applicable)
 - d. Motor bearing, drive end
 - e. Motor bearing, opposite end
 - f. Casing (bottom or top)
 - g. Casing (side)
 - h. Duct after flexible connection (discharge)
 - i. Duct after flexible connection (suction)

2. Test readings:
 - a. Horizontal, velocity and displacement
 - b. Vertical, velocity and displacement
 - c. Axial, velocity and displacement
 - d. Normally acceptable readings, velocity and acceleration
 - e. Unusual conditions at time of test
 - f. Vibration source (when non-complying)

- O. Instrument Calibration Reports:
 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCT INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- B. Section Includes: Insulation systems for sheet metal duct conveying cold, hot, and grease laden air.

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide duct insulation systems which have been manufactured, fabricated, and installed to meet all thermal requirements of mechanical systems. Insulating systems shall be installed in strict accordance with manufacturer's field requirements and the current International Energy Conservation Code including all local amendments and criteria specified herein.
- B. Performance Requirements: Provide duct insulation systems which have been manufactured and installed to meet the following standards:
- C.
 - 1. NFPA 90A.
 - 2. NFPA 90B.
 - 3. UL 723, ASTM E84: Flamespread 25, smoke developed 50.
 - 4. ASTM C1136: 150 degrees F.
 - 5. ASTM C1290.
 - 6. UL 181 for Class I Air Duct.
 - 7. NAIMA AHS-152T.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work
- C. Submit manufacturer's product data and installation instructions.
- D. Provide drawings indicating typical duct insulation details, thickness, and location. Identify areas and required insulation.
- E. Manufacturer's certificate that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated five (5) years experience on projects of similar size and complexity.

- B. Condensation on any insulated system is not acceptable. Contractor shall replace insulation deemed unacceptable due to exposure to condensation at no additional cost to project.
- C. Insulation to provide minimum R-value in accordance with current International Energy Conservation Code including all local amendments and criteria specified herein.

1.6 DELIVERY, STORAGE & HANDLING

- A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – MUST BE MANUFACTURED AND BRANDED BY ONE OF THE FOLLOWING:

- A. Fiber Glass Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Owens Corning
 - 2. Johns Manville
 - 3. CertainTeed
 - 4. Knauf brand Insulation
- B. Mastics and Adhesive: Subject to compliance with plans and specification, provide one of the following:
 - 1. Childers
 - 2. Foster
 - 3. Vimasco
- C. Fiberglass Reinforcing Cloth Mesh: Subject to compliance with plans and specification, provide one of the following:
 - 1. Perma Glass
 - 2. Alpha Glass
 - 3. Childers
 - 4. Vimasco

- D. Fire Wrap Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. 3M Fire Barrier Duct Wrap
 - 2. Vesuvius Pyroscat Duct Wrap
 - 3. Unifrax Corporation

2.2 DUCT WRAP

- A. Material: Resilient blanket of fiberglass insulation factory laminated to foil/kraft vapor retarder facing.
- B. Density: 0.75 pounds per cubic foot.
- C. Installed minimum R value: **8.3**.
- D. Nominal Thickness: **3.0** inches.
- E. Installed Thickness: **2-1/4** inches.
- F. Installed Thermal Conductivity (compressed): $k = 0.27$
- G. Operating Temperature (ASTM C411): up to 250° Fahrenheit.
- H. Insulation Jacket Temperature Limit (ASTM C1136): up to 150° Fahrenheit.
- I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120° Fahrenheit, 95% RH.
- J. Testing Method 1338: Fungi Resistance Comply with requirements.
- K. ASTM 665 Mineral Fiber Thermal Insulation: Comply with requirements.
- L. Surface Burning Characteristics (ASTM E84): Flame spread 25, smoke developed 50.

2.3 ACOUSTICAL FLEXIBLE DUCT LINER:

- A. Material: Acoustical insulation applied to interior of sheet metal ducts. Semi-rigid board of glass fibers with a tough, fire-resistant, anti-microbial, acrylic coating on the airstream side. Factory applied edge coating. Duct liner for rectangular and round duct as required.
- A. Density: 1.5 pounds per cubic foot.
- B. Installed minimum R value: 6.3.
- C. Thickness: 1-1/2 inches.
- D. Thermal Conductivity k , (ASTM C518): 0.24
- E. Acoustic Performance: Sound absorption coefficients at octave band center frequencies (Hz)

Freq. (Hz)	<u>125</u>	<u>250</u>	<u>500</u>	<u>1K</u>	<u>2K</u>	<u>4K</u>	<u>NRC</u>
TL (dB)	0.19	0.55	0.84	1.0	1.0	.98	.85
- F. Material Standards: Comply with NFPA 90A, NFPA 90B, and ASTM C1071.

- G. Operating Temperature (ASTM C411): 250 degrees Fahrenheit.
- H. Maximum Air Velocity (UL 181 Erosion test ASTM C1071): 6,000 fpm.
- I. Water Vapor Sorption (ASTM C1104): < 3 percent by weight at 120°F, 95% RH.
- J. Fungi Resistance (ASTM C1338 & G21): Comply with requirements.
- K. Bacteria Resistance (ASTM G22): Comply with requirements.
- L. Corrosiveness (ASTM C665): Will not cause corrosion greater than that caused by sterile cotton on aluminum or steel.
- M. Surface Burning Characteristics (ASTM E84, UL 723): Flame spread 25, smoke developed 50.

2.4 GREASE EXHAUST DUCT

- A. 1-1/2-inch-thick refractory ceramic blanket or calcia, magnesia and silica with aluminum foil, fiberglass-reinforced scrim encapsulation.
- B. Product to be UL Listed as a two (2) hour duct enclosure.
- C. Product shall be tested in accordance with the following:
 - 1. ASTM G 411
 - 2. ASTM C 51
 - 3. ASTM E 84
 - 4. ASTM E 119
 - 5. ASTM E 136
 - 6. ASTM E 814
 - 7. UL 1978 Sections 12 and B

2.5 ACCESSORIES

- A. Pressure-Sensitivity Aluminum Foil Tapes:
 - 1. Material Standard: Listed and labeled under UL 181A, Part I, identified by name, date of manufacture, product name/number and UL 181A.
 - 2. Size: At least 2-1/2 inches wide.
- B. Heat-Activated Tapes:
 - 1. Material Standard: Listed and labeled under UL 181A, Part II, identified by name, date of manufacture, product name/number and UL 181A, may be used in all applications except for bonding to sheet metal.
 - 2. Size: At least three (3) inches wide.
- C. Mastic and Glass Fabric System:
 - a. Material Standard: Listed and labeled under UL 181A, Part III.
 - b. Size: At least three (3) inches wide.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the duct insulation manufacturer.

3.2 INSTALLATION

A. ACOUSTICAL LINING OF SHEET METAL DUCT AND FITTINGS:

1. Completely cover all portions of duct designated to receive duct liner with duct liner material. Neatly butt all transverse joints with no interruptions or gaps. The black pigmented or mat faced surface of the duct liner shall face the airstream.
2. Affix duct liner to the sheet metal with 90 percent coverage of adhesive complying with the requirements of ASTM C916. All exposed leading edges and transverse joints shall be factory coated or coated with adhesive during fabrication.
3. Secure duct liner with mechanical fasteners, either weld-secured or impact-driven. Compress the duct liner sufficiently to hold it firmly in place. Adhesive bonded pins are not permitted. Space mechanical fasteners with respect to duct liner interior width as follows:
 - a. Maximum spacing for mechanical fasteners where air velocity is 0 – 2,500 FPM is as follows:
 1. From transverse end of liner: three (3) inches.
 2. Across width of duct: 12 inches on center.
 3. From corners of duct: four (4) inches.
 4. Along length of duct: 18 inches on center.
 - b. Maximum spacing for mechanical fasteners where air velocity is 2,501 – 5,000 FPM is as follows:
 1. From transverse end of liner: three (3) inches.
 2. Across width of duct: six (6) inches on center.
 3. From corners of duct: four (4) inches.
 4. Along length of duct: 16 inches on center.
4. Provide galvanized metal clips on all leading edges of duct liner. Exposed insulation is not acceptable.
5. Cut duct liner to ensure overlapped and compressed longitudinal corner joints.
6. Cut duct liner board to ensure tight, overlapped corner joints. Support the top pieces of liner board at the edges by the side pieces.
7. If the specification requires use of multiple insulation layers, take the following additional steps:
 - a. Affix bottom layer of duct liner in normal manner.
 - b. Affix top layer of duct liner to bottom layer using a minimum of 90% adhesive coverage.

- c. Treat the leading edges of the duct liner with galvanized angle clips to prevent separation of the 2 layers.
- d. Use mechanical fasteners of the proper length for the double layer.
- 8. Application: Provide duct liner as follows:
 - a. Provide duct liner in first 10 feet of duct from roof mounted exhaust fans.
 - b. Provide duct liner in all return air boots and transfer ducts.
 - c. Provide duct liner in the first 20 feet of supply duct from roof mounted air handling units / roof top units.

B. THERMAL INSULATION WRAP ON DUCT AND FITTINGS:

- 1. Before applying duct wrap, air ducts must be clean, dry, and tightly sealed at all joints and seams.
- 2. All portions of duct designated to receive duct wrap shall be completely covered with duct wrap.
- 3. To ensure installed thermal performance, duct wrap insulation shall be cut to “stretch-out” dimensions as shown in tables in manufacturer’s literature.
- 4. Remove a two (2) inch piece of insulation from the facing at the end of the piece of duct wrap to form an overlapping stapling and taping flap.
- 5. Install duct wrap insulation with facing outside so that the tape flap overlaps the insulation and facing at the other end of the piece of duct wrap. Adjacent sections of duct wrap insulation shall be tightly butted with the two (2) inch stapling and taping flap overlapping. On rectangular duct, install so insulation is not excessively compressed at corners. Staple seams approximately six (6) inches on center with 1/2-inch minimum steel outward clinching staples.
- 6. Seal seams and joints with **FSK tape**. Do not use cloth duct tape of any color or finish using reclaimed rubber adhesives on duct wrap insulation. Tightly butt adjacent sections of duct wrap with the two (2) inch tape flap overlapping.
- 7. Where rectangular ducts are 24 inches in width or greater, additionally secure duct wrap insulation to the bottom of the duct with mechanical fasteners such as pins and speed clip washers or cuphead weld pins, spaced on 18-inch centers (maximum) to prevent sagging of insulation. Do not overly compress insulation.
- 8. Seal all tears, punctures and other penetrations of the duct wrap facing using glass fabric and mastic.
- 9. Application: Provide duct wrap as follows:
 - a. All supply duct
 - b. All outside air supply and intake duct
 - c. All return air duct
 - d. All return air plenums on air units
 - e. All intake plenums on outside air handling units

- f. All ductwork routed in un-conditioned spaces including but not limited to un-conditioned plenums (non-return air plenums), attics, exterior soffits, ventilated mechanical/boiler rooms and crawl spaces.

C. GREASE EXHAUST DUCT AND FITTINGS:

1. Provide one (1) or two (2) layers of Ductwrap to create a 2-hour rated duct enclosure. Each layer shall be lapped a minimum of three (3) inches. Inner layer shall be held in place with one (1) inch wide filament tape, spaced 1-1/2 inch from edges and midway at 10-1-2 centers. The outer layer shall be offset by 10-1/2 inches of inner layer, and one (1) inch wide filament tape shall be used in same manner as inner layer. 1/2-inch x 0.015-inch carbon steel banding strips on shall be installed same dimensions as tape to secure both layers on duct. All horizontal and vertical support hangers shall be wrapped with 1-layer of fire rated duct wrap and be secured with stainless steel ties or 1/2-inch hose clamps.
2. Access Door Installation: Four galvanized steel threaded rods, 1/4-inch diameter by 5 inches long are to be welded to the duct at the corners of the door opening. Four steel tubes, each 3 inches long, are placed over the rods to act as protection for the duct wrap when fastening the door. Four insulation pins are to be welded to the door panel for installation of the blanket. One layer of duct wrap is cut approximately the same size as the access panel and impaled over the insulation pins on the panel. It is essential that this layer fit tightly against the wrap surrounding the access door opening with no through openings. A second layer of duct wrap is cut to overlap the first layer by a minimum of one (1) inch. The second layer is impaled over the pins and both layers are locked in place with galvanized speed clips. Pins that extend beyond the outer layer of duct wrap shall be turned down to avoid sharp points. The insulated door panel is placed over the threaded rods and held in place with washers and wing nuts. Provide an access door at each change in duct direction and a minimum of every 10 feet on straight duct.
3. Filament tape can be used to temporarily hold the blanket in place until the banding is applied. The steel banding is applied around the duct 1-1/2 inch from edge of the blanket, and maximum 10-1/2-inch centers. The banding is placed around the material and tightened so as to sufficiently hold the duct wrap in place against the duct, compressing the foil but not cutting the foil.
4. Additional Pinning to Prevent Sagging of Wrap: For ducts 24 inches and larger in width, additional pins are needed to support the blanket on the bottom horizontal surface and on the outside face of a vertical duct run. Space pins a maximum of 10-1/2 inches apart in the direction of the blanket width, and a maximum of 12 inches apart in the direction of the blanket length.
5. Provide 12 ga copper-coated steel insulation pins with 1.5-inch square or round cup-head pins. Insulation pins are to be welded to ducts.
6. Duct Support Systems: Provide one layer of insulation to cover support components. Maintain 3-inch overlap.
7. Application:
 - a. Provide 2-hour enclosure on grease exhaust duct. Enclosure shall extend from kitchen hood to underside of roof deck.

D. EXTERIOR OR INTERIOR EXPOSED DUCT

1. Duct shall be galvanized double wall insulated round or rectangular with perforated liner. Insulation shall be acrylic coated to prevent biological growth and airside erosion. Provide 2", 2.0 pcf insulation on exterior duct (installed R-value of 8.0) and 1-1/2", 1.5 pcf (installed R-Value of 6.0) on interior exposed duct. Duct and fittings shall use a bolted flange with neoprene gasket at each connection. Provide factory seal at flange and duct. Visual sealant on exposed interior duct to be painted is unacceptable.
2. Round duct to be galvanized spiral lockseam type.
3. Exposed round duct shall utilize single rod hangers with angle support rings. Double rod hangers are only acceptable on concealed duct.
4. Application: Provide double wall duct as follows:
 - a. Gymnasiums
 - b. Natatoriums
 - c. Return air plenums with ducted connection to return grilles
 - d. Ducted connections to return air grilles
 - e. Any area where ductwork is exposed

3.3 FIELD QUALITY CONTROL

- A. Inspection: Upon completion of installation of the duct system and before operation is to commence, visually inspect the system and verify that it has been correctly installed.
- B. Contractor shall inspect systems during test and balance to ensure that the formation of condensation is not present. Contractor shall be responsible for damage caused by condensation.

3.4 PROTECTION

- A. Protect installed work from damage due to subsequent construction activity on the site.

3.5 INSULATION SCHEDULE

- A. Supply and return ducts routed indoors (Ambient temperature \leq 85 degrees Fahrenheit, RH \leq 70 percent): R-8.3 (minimum).
- B. Supply, return, and exhaust ducts routed in unconditioned spaces including but not limited to un-conditioned plenums (non-return air plenums), attics, exterior soffits, mechanical/boiler rooms and crawl spaces. (Ambient temperature \leq 95 degrees Fahrenheit, RH \leq 70 percent): R-8.3 (minimum).
- C. Supply, return, and exhaust ducts routed outdoors or in spaces where temperature and relative humidity exceed that specified for unconditioned spaces: R-8.3 (minimum).
- D. R-values represent installed values.
- E. Provide multiple layers of insulation or thicker insulation to achieve R-values listed. If multiple layers are utilized, inner insulation layer shall not include vapor retarder.

END OF SECTION 23 07 13

SECTION 23 07 16 - HVAC EQUIPMENT INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section Includes:
 - 1. Chilled Water Components

1.2 SYSTEM DESCRIPTION

- A. Provide equipment insulation systems that have been manufactured, fabricated, and installed to meet the current International Energy Conservation Code and all local amendments and criteria specified herein.
- B. Performance Requirements: Provide equipment insulation systems which have been manufactured, fabricated, and installed to meet the following criteria:
 - 1. NFPA 90A Installation of Air Conditioning and Ventilation Systems.
 - 2. NFPA 90B Installation of Warm Air Heating and Air Conditioning Systems.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work
- C. Submit manufacturer's product data and installation instructions.
- D. Provide drawings indicating typical duct insulation details, thickness, and location. Identify areas and required insulation.
- E. Manufacturer's certificate that products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated five (5) years experience on projects of similar size and complexity.
- B. Condensation on any insulated system is not acceptable. Replace insulation damaged by condensation.
- C. Insulation to provide minimum R-Value in accordance with International Energy Conservation Code with Houston Amendment.

- D. Certifications: Manufacturer certification that products supplied meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver insulation materials in manufacturer's original, unopened containers with identification labels intact.
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass Fiber Pipe Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Johns Manville
 - 2. Owens-Corning
 - 3. Knauf
 - 4. Certainteed
- B. Cellular Glass Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Pittsburg Corning
 - 2. Cell-U-Form
- C. Aluminum Jacketing: Subject to compliance with plans and specification, provide one of the following:
 - 1. Perma Glass Mesh
 - 2. Alpha Glass Mesh
 - 3. Childers Chil-Glas
 - 4. Vimasco
 - 5. RPR Products Inc.
- D. Mastics and Adhesives: Subject to compliance with plans and specification, provide one of the following:
 - 1. Childers
 - 2. Foster

3. Vimasco

2.2 EQUIPMENT INSULATION

A. Glass Fiber Insulation Boards:

1. Thickness: Same thickness as connected piping.
2. Equipment Operating Temperature Limit (ASTM C411): Up to 450 degrees Fahrenheit.
3. Insulation Jacket Temperature Limit (ASTM C1136): -20 - 150 degrees Fahrenheit.
4. Vapor Retarder: ASJ vapor retarder facing.
5. Jacket Permeance (ASTM E96): 0.02 perm.
6. Jacket Puncture Resistance (ASTM D781): ASJ: 50 units.
7. Water Vapor Sorption (ASTM C1104): <2percent by weight at 120 degrees Fahrenheit.
8. Density: Same as adjoining pipe insulation.
9. Composition Surface Burning Characteristics (UL 723, ASTM E84): Flamespread 25, smoke developed 50.

B. Equipment and Tank Insulation:

1. Description: Flexible pipe and tank insulation made of semi-rigid fibrous glass board material with a laminated Kraft-aluminum foil ASJ facing.
2. Operating Temperature (ASTM C411): 0 - 650 degrees Fahrenheit.
3. Length: 36 inches.
4. Size: 1-1/2 inches.
5. Material Standard: Comply with ASTM C1393, Type II.
6. Material Standard: Comply with ASTM C795.
7. Material Standard: Comply with ASTM C1136, Type II.
8. Material Standard: Comply with NRC Guide 1.36.
9. Jacket Temperature Limitation (ASTM C1136): -20 - 50 degrees Fahrenheit.
10. Jacket Permeance (ASTM E961): 0.02 perm.
11. Puncture Resistance (ASTM D781): 50 units.
12. Compressive Strength at 10 % Deformation (ASTM C165): 125 psf.

2.3 CELLULAR GLASS INSULATION

- A. Rigid factory fabricated closed-cell equipment insulation:
 - 1. Thermal conductivity "k" of btuh-in / hr-sq.ft. degree F at 75-degree mean temperature.
 - 2. Density shall be an average of 8 lb./cu.ft.
 - 3. Compressive strength of 100 psi.

2.4 ALUMINUM JACKET

- A. Jacket for equipment and tanks shall be 0.16-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.
- B. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering. Fitting covers shall be manufactured to ASTM C-450 standards.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.
- C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.
- D. Do not apply insulation to equipment, breeching, or stacks while hot.
- E. Apply insulation using staggered joint method for both single- and double-layer construction, where feasible. Apply each layer of insulation separately.
- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least two (2) inches. Apply over vapor barrier where applicable.
- H. Do not insulate boiler manholes, hand holes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

- J. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by manufacturer.

3.2 MANUFACTURER'S INSTRUCTIONS

- A. Comply with the instructions and recommendations of the equipment insulation manufacturer.

3.3 EXAMINATION

- A. Site Verification of Conditions:
- B. Verify that site conditions are acceptable for installation of equipment insulation.
- C. Do not proceed with installation of equipment insulation until unacceptable conditions are corrected.

3.4 INDOOR CHILLED WATER PUMPS

- A. Shall be insulated with rigid insulation board, two (2) inch thick, cut and formed into a box and secured in place with 3/4-inch-wide x .020 galvanized bands spaced on nine (9) inch centers. Bands shall be pulled snug over sheets of insulation board. All joints shall be well and neatly fitted and so arranged that the assembly may be dismantled with ease permitting access to the pump. All voids on the interior of box shall be filled with glass fiber blanket insulation. Exterior shall be finished with a trowel coat of vapor barrier mastic, a layer of one (1) inch mesh galvanized wire, and a coat of cement. Final finish shall be an eight-ounce canvas jacket, pasted and sealed in place.
- B. Pipe insulation shall be extended over all cold parts of chilled water pumps not directly over drainage basin of pump base.

3.5 ALUMINUM JACKET

- A. Install insulating materials per manufacturer's recommendations.
- B. Install aluminum jacketing per manufacturer's recommendations.
- C. Apply aluminum jacketing by lapping, sealing with caulking mastic and strapping with 1/2-inch x 0.20-inch Type 3105 aluminum bands on 12-inch centers.
- D. Use screws on vertical lines at circumferential joints. Space screws a maximum of 6 inches apart with a minimum of two screws per joint.
- E. Lap joints against weather so that water will run off lower edge.
- F. Use caulking mastic to seal circumferential laps on horizontal lines, longitudinal laps on vertical lines, and lap formed where aluminum jacketing meets mastic. Also seal any screws in jacketing.
- G. Prevent corrosion-causing galvanic action by ensuring that aluminum jacketing does not come in direct contact with other metals.
- H. Waterproof valve, flange, and fitting covers and irregular shapes with mastic.

- I. Paint mastic with one coat of aluminum paint. Paint exposed metal parts (i.e., uninsulated valves, flanges, and fittings) with one coat of aluminum paint.
- J. Equipment exposed in mechanical rooms and finished spaces less than 10 feet above finished floor shall have specified aluminum jacket for protection.

3.6 ABOVE GRADE CHILLED WATER COMPONENTS, INSULATE WITH CELLULAR GLASS

- A. Location: Outdoor, un-conditioned spaces and ventilated spaces
- B. The insulation shall be applied to equipment with all joints tightly butted. Joints may be rubbed slightly to achieve a tight fit. Seal all joints full depth with sealant. Insulation shall be secured with strips of fiber reinforced tape on 12-inch centers. The tape strips shall overlap by 50 percent.
- C. Apply asphalt mastic and 6 x 6 mesh fabric in accordance with manufacturer's recommended procedures.
- D. Metal jacketing shall be applied over the vapor retarder mastic with all laps positioned to shed water. All laps should overlap a minimum of 2 inches. Bands shall be spaced no greater than 12 inches on center.
- E. After asphalt mastic application, fittings shall be covered with prefabricated metal fitting covers supplied by aluminum jacketing supplier.

3.7 INSULATION SCHEDULE

- A. Chilled water components located within condition spaces.
 - 1. Insulation thickness: Match adjoining piping thickness.
- B. Chilled water components located in un-conditioned or ventilated spaces and outdoors
 - 1. Insulation thickness: Match adjoining piping thickness.

3.8 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 07 16

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Pipe Insulation

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide pipe insulation systems which have been manufactured, fabricated, and installed to meet the current International Energy Conservation Code and all local amendments and criteria specified herein.
- B. Performance Requirements: Provide pipe insulation systems which have been manufactured, fabricated, and installed to meet the following criteria:
 - 1. NFPA 90A Installation of Air Conditioning and Ventilation Systems.

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by **highlighting** or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work.
- C. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
 - 1. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - b. Detail attachment and covering of heat tracing inside insulation.
 - c. Detail insulation application at pipe expansion joints for each type of insulation.
 - d. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - e. Detail removable insulation at piping specialties.
 - f. Detail application of field-applied jackets.
 - g. Detail application at linkages of control devices.

1.5 QUALITY ASSURANCE

- A. Installation Qualifications: Utilize an installer having demonstrated (5) five years experience on projects of similar size and complexity.
- B. Condensation on any insulated piping system is not acceptable. Replace insulation damaged by condensation at no additional cost.
- C. All materials shall conform to Composite Surface Burning Characteristics (UL 723, ASTM E84):
 - 1. Flamespread: 25
 - 2. Smoke developed: 50
- D. All materials shall have U.L. label.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver insulation materials in manufacturer's original, unopened, undamaged containers with identification labels intact
- B. Contractor shall adequately protect insulation from damage after delivery to the project. Materials shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver materials to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Glass Fiber Pipe Insulation: Subject to compliance with plans and specification, provide one of the following:
 - 1. Johns Manville
 - 2. Owens Corning
 - 3. Knauf

4. Certainteed
- B. Cellular Glass Insulation: Subject to compliance with plans and specification, provide one of the following:
 1. Pittsburg Corning
 2. Cell-U-Foam
- C. Phenolic Foam Insulation: Subject to compliance with plans and specification, provide one of the following:
 1. Resolco
 2. Koolphen® K
- D. Aluminum Jacketing: Subject to compliance with plans and specification, provide one of the following:
 1. Childers
 2. Pabco
 3. RPR
- E. Fiberglass Reinforcing Cloth Mesh: Subject to compliance with plans and specification, provide one of the following:
 1. Perma Glass Mesh
 2. Alpha Glass Mesh
 3. Childers Chil-Glas
 4. Vimasco
- F. Mastics and Adhesives: Subject to compliance with plans and specification, provide one of the following:
 1. Childers
 2. Foster
 3. Vimasco

2.2 FIBERGLASS PIPE INSULATION

- A. High density factory molded fiberglass insulation with factory applied all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Provide thickness scheduled.
 1. Thermal conductivity “k” of 0.23 of Btu-in / hr-sq.ft. °F at 75-degree mean temperature.
 2. Maximum jacket permeance shall be 0.02.

2.3 CELLULAR GLASS INSULATION

- A. Rigid factory fabricated closed-cell pipe insulation:
 1. Thermal conductivity “k” of 0.32 Btu-in / hr-sq.ft. °F at 75-degree mean temperature.
 2. Density shall be an average of 8 lb/cu.ft.
 3. Maximum jacket permeance shall be 0.02.
 4. Compressive strength of 100 psi.

2.4 PHENOLIC FOAM INSULATION

- A. Rigid factory molded phenolic foam insulation with factory applied, all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. Provide thickness scheduled.
 - 1. Thermal conductivity “k” of 0.15 btu-in / hr-sq.ft. °F at 75°-degree mean temperature.
 - 2. Maximum jacket permeance shall be 0.02.
 - 3. Compressive strength of 100 psi

2.5 ALUMINUM JACKET

- A. Jacket for piping shall be 0.016-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.
- B. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering.

PART 3 -EXECUTION

3.1 SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturer’s recommendations.

3.2 PREPARATION

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

3.3 INSTALLATION

- A. Install all insulation materials and accessories in accordance with manufacturer’s published instructions and recognized industry practices to ensure that it will serve its intended purpose.
- B. Install insulation on piping subsequent to installation of heat tracing, painting, and acceptance tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

- D. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears, or other damage. All staples used on cold pipe insulation shall be coated with suitable sealant to maintain vapor barrier integrity.
- E. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- F. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- G. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- H. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- I. Apply multiple layers of insulation with longitudinal and end seams staggered.
- J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- K. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- L. Keep insulation materials dry during application and finishing.
- M. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- N. Apply insulation with the least number of joints practical.
- O. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- P. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
- Q. Apply insulation continuously through hangers and around anchor attachments.
- R. For insulation application where vapor retarder is indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- S. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
- T. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

- U. Insulation Terminations: For insulation application where vapor retarder is indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- V. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- W. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
 - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder
 - 4. Vapor-Retarder Mastics: Where vapor retarder is indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings, at penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
 - 5. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
 - b. Seal penetrations with vapor-retarder mastic
 - c. Apply insulation for exterior applications tightly joined to interior insulation ends.
 - d. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
 - e. Seal metal jacket to roof flashing with vapor-retarder mastic.
 - 6. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
 - 7. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
 - 8. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
 - a. Fire stopping and fire-resistive joint sealers are specified in Division 7.
 - 9. Floor Penetrations: Apply insulation continuously through floor assembly.
 - a. For insulation with vapor retarder, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

- X. Insulation Installation of Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 feet to form a vapor stop between pipe insulation segments.
 3. For insulation with factory-applied jackets without integral vapor retarder, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- Y. Insulation Installation on Pipe Flanges:
1. Apply preformed cellular-glass pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cellular-glass block insulation.
 4. Install jacket material with manufacturers recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.
- Z. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of molded cellular-glass insulation and match thickness to that of adjoining pipe. Fittings and fabricated segments shall be securely held in place with $\frac{1}{2}$ inch x 0.20-inch type 3105 aluminum bands.
 - a. After segments have been banded, apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.
 - b. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.
 - c. Overlap mastic and fiberglass cloth by 2 inches on adjoining sections of pipe insulation.
- AA. Insulation Installation on Valves:
1. Install preformed two-piece factory molded cellular-glass insulation to valve body, match adjoining pipe insulation thickness. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. Install insulation to flanges as specified for flange insulation application.
 - a. After segments have been banded, apply a tack coat of insulating mastic to the insulated fitting to produce a smooth surface.
 - b. After mastic is dry, apply a second coat of vapor barrier mastic. Neatly embed with 10 x 10 fiberglass cloth into the tack coat.

- c. Overlap mastic and fiberglass cloth by 2 inches on adjoining sections of pipe insulation.

BB. PVC Cover:

1. Provide factory molded covers for all fittings, elbows, and flanges.

3.4 FIELD-APPLIED JACKET APPLICATION

- A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
 - a. Apply jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - b. Embed 10 x 10 fiberglass cloth between two 0.062-inch-thick coats of jacket manufacturer's recommended adhesive.
 - c. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
- B. Apply foil and paper jackets where indicated.
 - a. Draw jacket material smooth and tight.
 - b. Apply lap or joint strips with the same material as jacket.
 - c. Secure jacket to insulation with manufacturer's recommended adhesive.
 - d. Apply jackets with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints. Where vapor retarder is indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder mastic to ends of insulation at intervals of 15 feet to form a vapor stop between pipe insulation segments.
 - e. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

3.5 CHILLED WATER, CONDENSATE DRAIN AND MISCELLANEOUS PIPING SYSTEMS

- A. Location: Indoor, conditioned spaces - return air plenums, air handling unit rooms
- B. Insulation Type:
 1. Condensate Piping: **Fiberglass**
 2. Chilled Water Piping: **Phenolic Foam**
- C. Support Inserts: At each support point, install a hard section of cellular glass (two halves) around entire circumference of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Sealed and finished to match the adjoining insulation. Cellular glass length shall overhang a minimum of 2" on both sides of the saddle. Refer to 3.5, E for saddle length requirements.
- D. Provide formed 16 ga. galvanized sheet-metal saddles with flared edges for protection of vapor retarder jacket and insulation. Saddles shall be short ribbed to secure saddle inside

hanger, and prevention of saddle movement. Pipe saddles shall be secured on both ends with aluminum banding with a thickness of 0.20, 3/4" width and joined with 3/4" aluminum wing seals.

- E. Provide formed 16 ga. galvanized sheet-metal saddles as follows:
 - 3. Insert and saddle lengths:
 - a. 1-1/2 inch through 2-1/2-inch pipe - 10 inches Long
 - b. 3 inch through 6-inch pipe - 12 inches Long
 - c. 8 inch through 10-inch pipe - 16 inch Long
 - d. 12 inches and larger pipe - 22 inches Long
- F. Installation on Piping: All piping must be clean and dry at time of installation. Seal laps on jacket with adhesive. Provide 3-inch butt strips at each joint between sections and seal with adhesive.
- G. Provide vapor retarder on all cold-water piping. Install a sealed vapor stop every 15 feet.

3.6 CHILLED WATER, CONDENSATION DRAIN AND MISCELLANEOUS PIPING SYSTEMS

- A. Location: Outdoor, un-conditioned spaces (non-return air plenums) and ventilated spaces. Shall include but not limited to non-return air plenum mechanical rooms, chiller rooms, and pump rooms.
- B. Insulation Type:
 - 1. Condensate Piping: **Fiberglass**
 - 2. Chilled Water Piping: **Phenolic Foam**
- C. Cellular Glass Installation:
 - 1. The insulation shall be applied to piping with all joints tightly butted. Joints may be rubbed slightly to achieve a tight fit. Seal all joints full depth with sealant. Insulation shall be secured with strips of fiber reinforced tape on 12-inch centers. The tape strips shall overlap by 50 percent.
 - 2. Apply asphalt mastic and 6 x 6 mesh fabric in accordance with manufacturer's recommended procedures.
 - 3. Aluminum jacketing shall be applied over the vapor retarder mastic with all laps positioned to shed water. All laps should overlap a minimum of 2 inches. Bands shall be spaced no greater than 12 inches on center.
 - 4. After asphalt mastic application, fittings shall be covered with prefabricated metal fitting covers supplied by aluminum jacketing supplier.
- D. Support Inserts: At each support point, install a hard section of cellular glass (two halves) around entire circumference of piping, same thickness as adjacent insulation, to prevent compression at support bearing area. Sealed and finished to match the adjoining insulation.
- E. Provide formed 14 ga. galvanized sheet-metal saddles with flared edges for protection of vapor retarder jacket and insulation. Saddles shall be short ribbed to secure saddle inside hanger, and prevention of saddle movement. Pipe saddles shall be secured on both ends

with aluminum banding with a thickness of 0.20, 3/4" width and joined with 3/4" aluminum wing seals.

- F. Provide formed 14 ga. galvanized sheet-metal saddles as follows:
 - 1. Insert and saddle lengths:
 - a. 1-1/2 inch through 2-1/2-inch pipe - 10 inches Long
 - b. 3 inch through 6-inch pipe - 12 inches Long
 - c. 8 inch through 10-inch pipe - 16 inch Long
 - d. 12 inches and larger pipe - 22 inches Long
- G. Installation on Piping: All piping must be clean and dry at time of installation. Seal laps on jacket with adhesive and vapor retarder mastic. Provide 3-inch butt strips at each joint between sections and seal with adhesive.
- H. Provide vapor retarder on all cold-water piping. Install a sealed vapor stop every 15 feet.

3.7 ALUMINUM JACKET

- A. Install insulating materials per manufacturer's recommendations.
- B. Install aluminum jacketing per manufacturer's recommendations.
- C. Apply aluminum jacketing by lapping and sealing with caulking mastic and strapping with 1/2-inch x 0.20-inch Type 3105 aluminum bands on 12-inch centers.
- D. Use screws on vertical lines at circumferential joints. Space screws a maximum of 6 inches apart with a minimum of two screws per joint.
- E. Lap joints against weather so that water will run off lower edge.
- F. Use caulking mastic to seal circumferential laps on horizontal lines, longitudinal laps on vertical lines, and lap formed where aluminum jacketing meets mastic. Also seal any screws in jacketing.
- G. Prevent corrosion-causing galvanic action by ensuring that aluminum jacketing does not come in direct contact with other metals.
- H. Waterproof valve, flange, and fitting covers and irregular shapes with mastic.
- I. Paint mastic with one coat of aluminum paint. Paint exposed metal parts (i.e., uninsulated valves, flanges, and fittings) with one coat of aluminum paint.
- J. **Pipe exposed in mechanical rooms and finished spaces less than 10 feet above finished floor shall have specified aluminum jacket for protection.**
- K. All exterior pipes shall have specified aluminum jacket for protection.

3.8 PROTECTION

- A. Replace damaged aluminum jacketing and insulation, including insulation with vapor barrier damage and moisture-saturated insulation.

- B. The insulation contractor shall advise the general and / or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.9 INSULATION SCHEDULE

- A. Chilled water piping located within condition spaces.
 - 1. Insulation thickness (**Phenolic Foam**):
 - a. **1-1/2"** thick insulation for: 1/2" through 2" pipe
 - b. **2"** thick insulation for: 2-1/2" and larger pipe
- B. Chilled water piping located in un-conditioned or un-ventilated spaces and outdoors.
 - 1. Insulation thickness (**Phenolic Foam**):
 - a. **1-1/2"** thick insulation for: 1/2" through 2" pipe
 - b. **2"** thick insulation for: 2-1/2" and larger pipe
- C. Cold Condensate Drain Lines
 - 1. Insulation thickness: (**Fiberglass**):
 - a. 1" thick insulation for all pipe sizes and locations

END OF SECTION 23 07 19

SECTION 23 08 00 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- B. Related Sections:
 - 1. Section 019114 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

1.5 ALLOWANCES

- A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Section 012100 "Allowances."

1.6 UNIT PRICES

- A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Section 012200 "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

1.7 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.

- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.8 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

1.9 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
 - 6. Test and inspection reports and certificates.
 - 7. Corrective action documents.
 - 8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 Testing AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least [10] days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
 - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the HVAC&R Subcontractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.
- B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230993 "Sequence and Operations for HVAC Controls." Assist the CxA with preparation of testing plans.
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R **Subcontractor** shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to

Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.

2. Description of equipment for flushing operations.
 3. Minimum flushing water velocity.
 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- E. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.
- H. Refer to plans and specifications for HVAC system type.

END OF SECTION 23 08 00

SECTION 23 09 23 - DIRECT DIGITAL CONTROLS

GENERAL CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.01 Work Included:

- A. GENERAL - Building Management System (BMS) Contractor shall provide and install:
 - 1. Tie in new DDC controls to the existing Campus system on site.
 - 2. New all wiring, conduit, panels, and accessories for a complete operational system. Meet TFC standards and electrical section requirements.
 - 3. Electrical contractor shall install all conduit required for controls contractor.
 - 4. Controls contractor shall provide all control valves for the chilled water and hot water systems.

- B. GENERAL PRODUCT DESCRIPTION
 - 1. All new system materials and equipment will tie into the existing system on campus which is a BACnet™ system.

1.02 Products Furnished but Not Installed Under This Section

- A. Control valves
- B. Duct Mounted Dampers
- C. Flow Measuring Instruments
- D. Immersion wells

1.03 Products Installed but Not Furnished Under This Section

- A. Boiler sequencer panel system

1.04 Related Sections

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.

- B. The following sections constitute related work:
 - 1. Section 01 00 00 - General and Special Requirements
 - 2. Section 01 33 00 - Submittal Requirements
 - 3. Section 23 00 00 - Mechanical
 - 4. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC

1.05 Approved Control System Contractors and Managers

- A. The following are the approved Control System Contractors:
1. Schneider Electric: Contact Shawn Pierce – (210) 669-3301
 2. Entech Sales and Service: Contact Brian Simmons – (214) 802-5204

1.06 Codes and Standards

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:
1. National Electric Code (NEC)
 2. Uniform Building Code (UBC)

1.1 SYSTEM DESCRIPTION

- A. All network area controllers shall be capable of communicating with districts server software which is Schneider Electric. The network area controllers are to communicate using the Schneider Electric framework. The BMS contractor shall seamlessly integrate existing controllers with new controllers into new system for functionality and final graphics package.
- B. The entire Temperature Control System (TCS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via LonMark™/LonTalk™ and/or BACnet™ communication protocols to a Network Area Controller (NAC). Temperature Control System products shall be by approved manufacturers. Equivalent LonWorks™ or BACnet™ products must be approved in writing by the consulting Engineer/Owner and be submitted for approval ten (10) days prior to the date of the bid submittal.
- C. The Temperature Control Systems (TCS) consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and perform functions specified.
- D. The Facility Management and Control System (FMCS) shall be comprised of Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the owner's local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each NAC shall communicate to LonMark™/LonTalk™ (IDC) and/or BACnet™ (IBC) controllers and other open protocol systems/devices provided under Division 23 or Division 26.
- E. The Facility Management and Control System (FMCS) as provided in this Division shall be based on a hierarchical architecture incorporating the Schneider Electric Ecostruxure. Equivalent products must be approved in writing by the consulting Engineer/Owner and be submitted for approval ten (10) days prior to the date of the bid submittal. Systems not developed on the Schneider Electric Ecostruxure platform are unacceptable.

- F. The Facility Management and Control System (FMCS) shall monitor and control equipment as called for by the “Sequence of Operation” and points list.
- G. The Facility Management and Control System (FMCS) shall provide full graphic software capable of complete system operation for up to 34 simultaneous Thin-Client workstations.
- H. The Facility Management and Control System (FMCS) shall provide full graphic operator interface to include the following graphics as a minimum:
 - 1. Home page to include a minimum of six critical points, i.e. Outside Air Temperature, Outside Air Relative Humidity, Enthalpy, KWH, KW etc.
 - 2. Graphic floor plans accurately depicting rooms, walls, hallways, and showing accurate locations of space sensors and major mechanical equipment.
 - 3. Detail graphics for each mechanical system to include; AHUs (Air Handling Units), ERUs (Energy Recovery Units), TUs (Terminal Units), EFs (Exhaust Fans), Chillers and associated controls, Boilers, and Converters as a minimum.
- I. The FMCS shall provide automated alarming software capable of sending messages to email compatible cellular telephones and pagers via the owner’s e-mail service. The email alarm paging system shall be able to segregate users, time schedules, and equipment, and be capable of being programmed by the owner.
- J. It is preferable that any dedicated configuration tool required for controller configuration have the capability to be launched from within the applicable Network Management Software. If the configuration tool(s) cannot be launched from the Network Management Software, any software required for controller configuration shall be included as a leave-behind tool with enough license capability to support the installation.
- K. The contractor shall provide the appropriate quantity of legal copies of all software tools, configuration tools, management tools, and utilities used during system commissioning and installation. All tools shall be generally available in the market. No closed and/or unavailable tools will be permitted. Contractor shall convey all software tools and their legal licenses at project close out.

1.2 SUBMITTAL

- A. Copies of shop drawings of the components and devices for the entire control system shall be submitted and shall consist of a complete list of materials, including manufacturers catalog data sheets and installation instructions for all controllers, valves, dampers, sensors, routers, etc. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. Sequence of Operation and Points list to be provided by the Mechanical Engineer of Record and on the project drawings. Division 26 contractors supplying products and systems, as part of their packages shall provide catalog data sheets, wiring diagrams and point lists to the Owner’s BAS contractor for proper coordination of work.

- B. Submittal shall also include a trunk cable schematic diagram depicting operator workstations and a description of the communication type, media, and protocol. Though the Division 23 and 26 contractors shall provide these diagrams for their portions of work, the Systems Integrator shall be responsible for integrating those diagrams into the overall trunk cable schematic diagrams for the entire Wide Area Network (WAN) and/or Local Area Network (LAN) utilized by the FMCS.
1. The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system expansion with minimal infrastructure modifications.
- C. Submittal shall also include a complete point list of all points to be connected to the TCS and FMCS. Engineer/Division 15 and 16 contractors shall provide necessary point lists, protocol documentation, and factory support information for systems provided in their respective divisions but integrated into the FMCS.
- D. Upon completion of the work, provide a complete set of ‘as-built’ drawings and application software electronically. Drawings shall be provided as AutoCAD™ or Visio™ compatible files. Division 15 and 16 contractors shall provide as-builts for their portions of work. The Owner’s BAS contractor shall be responsible for as-builts pertaining to overall TCS and FMCS architecture and network diagrams.

1.3 SPECIFICATION NOMENCLATURE

- A. Acronyms used in this specification are as follows:

DDC	Direct Digital Controls
FMCS	Facility Management and Control System
GUI	Graphical User Interface
IBC	Interoperable BACnet Controller
IDC	Interoperable Digital Controller
LAN	Local Area Network
NAC	Network Area Controller
OOT	Object Oriented Technology
PICS	Product Interoperability Compliance Statement
PMI	Power Measurement Interface
POT	Portable Operator’s Terminal
TCS	Temperature Control System
WAN	Wide Area Network

WBI Web Browser Interface

1.4 DIVISION OF WORK

- A. Owner’s BAS contractor shall be responsible for all controllers (IDC and IBC), control devices, control panels, controller programming, controller programming software, controller input/output and power wiring and controller network wiring. All unit safeties provided and installed by mechanical and/or electrical contractor.
- B. Owner’s BAS contractor shall be responsible for the Network Area Controller(s) (NAC), software and programming of the NAC, graphical user interface software (GUI), development of all graphical screens, Web browser pages, setup of schedules, logs and alarms, LonWorks network management and connection of the NAC to the local or wide area network.

1.5 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 26, Electrical:
 - 1. Providing motor starters and disconnect switches (unless otherwise noted).
 - 2. Power wiring and all conduit (unless otherwise noted).
 - 3. Provision, installation and wiring of smoke detectors (unless otherwise noted).
 - 4. Other equipment and wiring as specified in Division 26.

1.6 AGENCY AND CODE APPROVALS

- A. All products of the TCS and FMCS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
 - 1. UL-916; Energy Management Systems
 - 2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 “signal Equipment”
 - 3. CE
 - 4. FCC, Part 15, Subpart J, Class A Computing Devices

1.7 SOFTWARE LICENSE AGREEMENT

- A. The Owner shall agree to the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.
- B. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project

and/or configured for use with the NAC, FMCS, and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner.

- C. The owner, or his appointed agent, shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and /or configured for use within Niagara AX Framework (Niagara) based controllers and/or servers and any related LAN / WAN / Intranet and all connected routers and devices.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-shipping cartons/boxes for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.9 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

A. .

1.07 Submittals

- A. Project Record Documents: Submit three copies of record (as-built) documents upon completion of installation. Submittal shall consist of:
 - 1. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Part 3: "Control System Demonstration and Acceptance."

PART 2 – PRODUCTS

1.10 GENERAL

- A. The Temperature Control System (TCS) and Facility Management Control System (FMCS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein.
- B. The installed system shall provide secure password access to all features, functions and data contained in the overall FMCS.

1.11 ACCEPTABLE MANUFACTURERS

- 1. Schneider Electric

1.12 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet™, LonWorks™ technology, MODBUS™, OPC, and other open and proprietary communication protocols into one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-2001, BACnet and LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file and a resource file for the device. For each BACnet device, the device supplier must provide a PICS document showing the installed device’s compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP,) and/or RS-485 (BACnet MSTP) as specified.
- C. All components and controllers supplied under this Division shall be true “peer-to-peer” communicating devices. Components or controllers requiring “polling” by a host to pass data shall not be acceptable.
- D. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. Systems requiring proprietary database and user interface programs shall not be acceptable.
- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer’s internal Intranet network. Systems employing a “flat” single tiered architecture shall not be acceptable.
 - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for local network connected user interfaces.
 - 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

1.13 NETWORKS

- A. The Local Area Network (LAN) shall be a 100 Megabit/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.
- B. Local area network minimum physical and media access requirements:
 - 1. Ethernet; IEEE standard 802.3
 - 2. Cable; 100 Base-T, UTP-8 wire, category 5
 - 3. Minimum throughput; 100 Mbps.

1.14 NETWORK ACCESS

A. Remote Access.

1. For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The Owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

1.15 NETWORK AREA CONTROLLER (NAC)

A. The Owner's BAS contractor shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of area controllers required is dependent on the type and quantity of devices provided under Divisions 15 and 16. It is the responsibility of the Owner's BAS contractor to coordinate with the Division 15 and 16 contractors to determine the quantity and type of devices.

B. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:

1. Calendar functions
2. Scheduling
3. Trending
4. Alarm monitoring and routing
5. Time synchronization
6. Integration of LonWorks controller data and BACnet controller data
7. Network Management functions for all LonWorks and/or BACnet based devices

C. The Network Area Controller shall provide the following hardware features as a minimum:

1. One Ethernet Port – 10/100 Mbps
2. One RS-232 port
3. One LonWorks Interface Port – 78KB FTT-10A if Lon controllers are used and/or One RS-485 port if BACnet controllers are used.
4. Battery Backup
5. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
6. The NAC must be capable of operation over a temperature range of 32 to 122°F
7. The NAC must be capable of withstanding storage temperatures of between 0 and 158°F
8. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

- D. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
- E. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.
- F. Event Alarm Notification and actions
 - 1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 - 2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network, or remote via dial-up telephone connection or wide-area network.
 - 3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:
 - a. In alarm
 - b. Return to normal
 - c. Fault condition
 - 4. Provide for the creation of a minimum of eight alarm classes for the purpose of routing types and/or classes of alarms, i.e.: security, HVAC, Fire, etc.
 - 5. Provide timed (schedule) routing of alarms by class, object, group, or node.
 - 6. Provide alarm generation from binary object “runtime” and/or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
- G. Controller and network failures shall be treated as alarms and annunciated.
- H. Alarms shall be annunciated in any of the following manners as defined by the user:
 - 1. Screen message text
 - 2. Email of the complete alarm message to multiple recipients via the owner’s e-mail service. Provide the ability to route and email alarms based on:
 - a. Day of week
 - b. Time of day
 - c. Recipient
 - 3. Pagers via paging services that initiate a page on receipt of email message via the owner’s e-mail service
 - 4. Graphic with flashing alarm object(s)
 - 5. Printed message, routed directly to a dedicated alarm printer
- I. The following shall be recorded by the NAC for each alarm (at a minimum):
 - 1. Time and date

2. Location (building, floor, zone, office number, etc.)
 3. Equipment (air handler #, access way, etc.)
 4. Acknowledge time, date, and user who issued acknowledgement.
 5. Number of occurrences since last acknowledgement.
- J. Alarm actions may be initiated by user defined programmable objects created for that purpose.
- K. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- L. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.
- M. Provide a “query” feature to allow review of specific alarms by user defined parameters.
- N. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
- O. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.
- 1.16 Data Collection and Storage
- A. The NAC shall have the ability to collect data for any property of any object and store this data for future use.
- B. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:
1. Designating the log as interval or deviation.
 2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
 3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
 4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
 5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
- C. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web browser.
- D. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
- E. All log data shall be available to the user in the following data formats:
1. HTML
 2. XML
 3. Plain Text

4. Comma or tab separated values
 5. PDF
- F. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
- G. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:
1. Archive on time of day
 2. Archive on user-defined number of data stores in the log (buffer size)
 3. Archive when log has reached it's user-defined capacity of data stores
 4. Provide ability to clear logs once archived

1.17 AUDIT LOG

- A. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
1. Time and date
 2. User ID
 3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

1.18 DATABASE BACKUP AND STORAGE

- A. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
- B. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.
- C. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

1.19 ADVANCED UNITARY CONTROLLER

- A. The controller platform shall be designed specifically to control HVAC – ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes: constant volume air handlers, VAV air handlers, packaged RTU, heat pumps, unit vents, fan coils, natural convection units, and radiant panels. The controller platform shall provide options and advanced system functions, programmable and configurable using Schneider Electric Ecostruxure Building Operation (EBO), that allow standard and customizable control solutions required in executing the “Sequence of Operation” as outlined in Section 4.
- B. Minimum Requirements:
1. The controller shall be capable of either integrating with other devices or stand-alone operation.

2. The controller shall have an FTT transformer-coupled communications port interface for common mode-noise rejection and DC isolation.
3. The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
 - a. Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
 - b. Accuracy: ± 1 minute per month at 77° F (25° C).
 - c. Power Failure Backup: 24 hours at 32° to 122° F (0° to 50° C).
4. The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
5. The controller shall have an internal DC power supply to power external sensors.
 - a. Power Output: 20 VDC $\pm 10\%$ at 75 mA.
6. The controller shall have a visual indication (LED) of the status of the device:
 - a. Controller operating normally.
 - b. Controller in process of download.
 - c. Controller in manual mode under control of software tool.
 - d. Controller lost its configuration.
 - e. No power to controller, low voltage, or controller damage.
 - f. Processor and/or controller are not operating.
7. The minimum controller Environmental ratings
 - a. Operating Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).
 - b. Storage Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).
 - c. Relative Humidity: 5% to 95% non-condensing.
8. The controller shall have the additional approval requirements, listings, and approvals:
 - a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
 - b. CSA (LR95329-3) Listed
 - c. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
 - d. Meets Canadian standard C108.8 (radiated emissions).
 - e. Conforms to the following requirements per European Consortium standards:
EN 61000-6-1; 2001 (EU Immunity)
EN 61000-6-3; 2001 (EU Emissions)
9. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).

10. The controller shall have sufficient on-board inputs and outputs to support the application.
 - a. Analog outputs (AO) shall be capable of being configured to support 0-10 V, 2-10 V or 4-20 mA devices.
 - b. Triac outputs shall be capable of switching 30 Volts at 500 mA.
 - c. Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring. Input and Output wiring terminals shall be designated with color coded labels.
 - d. Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).
11. The controller shall provide for “user defined” Network Variables (NV) for customized configurations and naming using Schneider Electric Ecostruxure.
 - a. The controller shall support 62 Network Variables with a byte count of 31 per variable.
 - b. The controller shall support 1,922 separate data values.
12. The controller shall provide “continuous” automated loop tuning with an Adaptive Integral Algorithm Control Loop.
13. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized “sequence of operations” as outlined in Section 4.
 - a. Discharge air control and low limit
 - b. Pressure-dependent dual duct without flow mixing.
 - c. Variable air volume with return flow tracking.
 - d. Economizer with differential enthalpy.
 - e. Minimum air flow coordinated with CO2.
 - f. Unit ventilator cycle (1,2,3) 2-pipe.
 - g. Unit ventilator cycle (1,2,3) 2-pipe with face/bypass.

1.20 ADVANCED VARIABLE AIR VOLUME CONTROLLER

- A. The controller platform shall be designed specifically for room-level VAV control – pressure-independent air flow control, pressure dependent damper control, supply and exhaust pressurization/de-pressurization control; temperature, humidity, complex CO2, occupancy, and emergency control. Equipment includes: VAV terminal unit, VAV terminal unit with reheat, Series fan powered terminal unit, Parallel fan powered terminal unit, Supply and Exhaust air volume terminals, and Constant volume dual-duct terminal unit. The controller platform shall provide options and advanced system functions, programmable and configurable using Schneider Electric Ecostruxure Building Operation (EBO), that allow standard and customizable control solutions required in executing the “Sequence of Operation” as outlined in Section 4.
- B. Minimum Requirements:

1. The controller shall be capable of either integrating with other devices or stand-alone room-level control operation.
2. The controller shall have an internal velocity pressure sensor.
 - a. Sensor Type: Microbridge air flow sensor with dual integral restrictors.
 - b. Operating Range: 0 to 1.5 in. H₂O (0 to 374 Pa).
 - c. Accuracy: $\pm 2\%$ of full scale at 32° to 122° F (0° to 50° C); $\pm 1\%$ of full scale at null pressure.
3. The controller shall have an FTT transformer-coupled communications port interface for common mode-noise rejection and DC isolation.
4. The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
 - a. Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
 - b. Accuracy: ± 1 minute per month at 77° F (25° C).
 - c. Power Failure Backup: 24 hours at 32° to 122° F (0° to 50° C).
5. The controller shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
6. The controller shall have an internal DC power supply to power external sensors.
 - a. Power Output: 20 VDC $\pm 10\%$ at 75 mA.
7. The controller shall have a visual indication (LED) of the status of the device:
 - a. Controller operating normally.
 - b. Controller in process of download.
 - c. Controller in manual mode under control of software tool.
 - d. Controller lost its configuration.
 - e. No power to controller, low voltage, or controller damage.
 - f. Processor and/or controller are not operating.
8. The minimum controller Environmental ratings:
 - a. Operating Temperature Ambient Rating: 32° to 122° F (0° to 50° C).
 - b. Storage Temperature Ambient Rating: -40° to 122° F (-40° to 50° C).
 - c. Relative Humidity: 5% to 95% non-condensing.
9. The controller shall have the additional approval requirements, listings, and approvals:
 - a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
 - b. CSA (LR95329-3) Listed
 - c. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.

- d. Meets Canadian standard C108.8 (radiated emissions).
 - e. Conforms to the following requirements per European Consortium standards:
 - EN 61000-6-1; 2001 (EU Immunity)
 - EN 61000-6-3; 2001 (EU Emissions)
10. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).
11. The controller shall provide an integrated actuator option.
- a. Actuator type: Series 60 Floating.
 - b. Rotation stroke: $95^{\circ} \pm 3^{\circ}$ for CW or CCW opening dampers.
 - c. Torque rating: 44 lb-in. (5 Nm).
 - d. Run time for 90° rotation: 90 seconds at 60 Hz.
12. The controller shall have sufficient on-board inputs and outputs to support the application.
- a. Analog outputs (AO) shall be capable of being configured to support 0-10 V, 2-10 V or 4-20 mA devices.
 - b. Triac outputs shall be capable of switching 30 Volts at 500 mA.
 - c. Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring. Input and Output wiring terminals shall be designated with color coded labels.
 - d. Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).
- .
13. The controller shall provide for “user defined” Network Variables (NV) for customized configurations and naming using Schneider Electric Ecostruxure Building Operation (EBO).
- a. The controller shall support a range of Network Variables to 62 with a byte count of 31 per variable.
 - b. The controller shall support 1,922 separate data values.
14. The controller shall provide continuous automated loop tuning with an Adaptive Integral Algorithm Control Loop.
15. The controller shall have a loop execution response time of 1 second.
16. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized “sequence of operations” as outlined in Section 4.
- a. VAV terminal unit.
 - b. VAV terminal unit fan speed control.
 - c. Series fan.
 - d. Parallel fan.

- e. Regulated air volume (room pressurization/de-pressurization).
- f. CV dual-duct
- g. Room CO2 control
- h. Room Humidity
- i. TOD occupancy sensor stand-by setpoints

1.21 GRAPHICAL USER INTERFACE SOFTWARE

A. Operating System:

1. The Workstation with GUI shall run on an Owner supplied approved Microsoft Windows platform.

- ### B. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimal knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

C. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:

1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of, a graphic background the GUI shall support the use of scanned pictures.
2. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
3. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
4. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
 - a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - b. Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.
5. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No text entry shall be required.
6. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No text entry shall be required.

- D. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
- a. Create, delete, or modify control strategies.
 - b. Add or delete objects to the system.
 - c. Tune control loops through the adjustment of control loop parameters.
 - d. Enable or disable control strategies.
 - e. Generate hard copy records or control strategies on a printer.
 - f. Select points to be alarmable and define the alarm state.
 - g. Select points to be trended over a period of time and initiate the recording of values automatically.
- E. On-Line Help. Provide a context sensitive on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for the currently displayed screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
- F. Security. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off the system if no keyboard or mouse activity is detected for a specified time. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
- G. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
- H. Alarm Console
1. The system shall be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console may be enabled or disabled by the system administrator.
 2. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and unacknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

1.22 WEB BROWSER CLIENTS

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Mozilla Firefox™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

- B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall not be acceptable.
- C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface (if used). Systems that require different graphic views, different means of graphic generation, or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- D. The Web browser client shall support at a minimum, the following functions:
 - 1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
 - 2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
 - 3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
 - 4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
 - 5. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
 - 6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 - 1. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - 2. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No text entry shall be required.
 - c. View logs and charts
 - d. View and acknowledge alarms
 - e. Setup and execute SQL queries on log and archive information
 - 7. The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to set a specific home page for

each user. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

1.23 SERVER FUNCTIONS AND HARDWARE

- A. A central server shall be provided by the Owner. The server shall support all Network Area Controllers (NAC) connected to the customer's network whether local or remote.
- B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.
- C. It shall be possible to provide access to all Network Area Controllers via a single connection to the server. In this configuration, each Network Area Controller can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.
- D. The server shall provide the following functions, at a minimum:
 1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
 2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.
 3. The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC).
 4. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
 5. The server shall provide scheduling for all Network Area Controllers and their underlying field control devices.
 6. The server shall be capable of providing demand limiting that operates across all Network Area Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
 7. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers. Systems not employing this prioritization shall not be accepted.
 8. Each Network Area Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
 9. The server shall provide central alarm management for all Network Area Controllers supported by the server. Alarm management shall include:
 1. Routing of alarms to display, printer, email and pagers

2. View and acknowledge alarms
 3. Query alarm logs based on user-defined parameters
10. The server shall provide central management of log data for all Network Area Controllers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
1. Viewing and printing log data
 2. Exporting log data to other software applications
 3. Query log data based on user-defined parameters
- E. Server Hardware Requirements: The server hardware platform shall have the following requirements:
1. The computer shall be, at minimum, an Intel Core 2 Duo Processor based computer (minimum processing speed of 2.66 GHz with 2 GB RAM and a 120-gigabyte minimum SATA hard drive). It shall include a DVD-RW Drive, 1GB Non-ECC DDR2 (1 module), mouse, keyboard, asynchronous serial port, and 2-USB ports. A minimum 17" flat panel color monitor, 1280 x 1024 optimal preset resolution, with a minimum 80HZ refresh rate shall also be included.
 2. The server operating system shall be the latest approved Microsoft Windows Server platform.
 3. Connection to the FMCS network shall be via an Ethernet network interface card, 10/100/1000 Mbps.

1.24 SYSTEM CONFIGURATION TOOL

- A. The Workstation Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.
- B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.
- C. Programming Methods
 1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy

identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.

2. Configuration of each object will be done through the object’s property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, or a manufacturer-specific procedural language for configuration will not be accepted.
3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.
5. The system shall support object duplication within a customer’s database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

1.25 LonWorks NETWORK MANAGEMENT

- A. The Graphical User Interface software (GUI) shall provide a complete set of integrated LonWorks network management tools for working with LonWorks networks. These tools shall manage a database for all LonWorks devices by type and revision, and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between LonWorks devices, known as “binding”. Systems requiring the use of third party LonWorks network management tools shall not be accepted.
- B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
- C. The network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.
- D. These tools shall provide the ability to “learn” an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.
- E. The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times, within the control system, shall not be accepted.

1.26 LIBRARY

- A. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
- B. The objects in this library shall be capable of being copied and pasted into the user’s database and shall be organized according to their function. In addition, the user shall have

the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

- C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.
- D. All control objects shall conform to the control objects specified in the BACnet specification.
- E. The library shall include applications or objects for the following functions, at a minimum:
 - 1. Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.
 - 2. Calendar Object. . The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical “point-and-click” selection. This object must be “linkable” to any or all scheduling objects for effective event control.
 - 3. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals
 - 4. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.
 - 5. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building’s “flywheel” effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day’s performance.
 - 6. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order

in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

- F. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.
1. Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
 2. Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.
 3. Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an “on” condition. The user must be able to specify either input condition as the “on” condition.
 4. Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.
 5. PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.
 6. Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.
 7. Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
 8. Custom Programming Objects - Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including math and logic functions, string manipulation, and e-mail as a minimum. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for re-use.
 9. Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air,

supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.

10. Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an “On” state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.
 11. Composite Object - Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering, or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the “contained” application that are represented on the graphical shell of this container.
- G. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). At a minimum, provide the following as part of the standard library included with the programming software:
1. LonMark/LonWorks devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. All network variables defined in the LonMark profile shall be supported. Information (type and function) regarding network variables not defined in the LonMark profile shall be provided by the device manufacturer.
 2. For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file and documentation for the device to facilitate device integration.
 3. For BACnet devices, provide the following objects at a minimum:
 - a. Analog In
 - b. Analog Out
 - c. Analog Value
 - d. Binary
 - e. Binary In
 - f. Binary Out
 - g. Binary Value
 - h. Multi-State In
 - i. Multi-State Out
 - j. Multi-State Value
 - k. Schedule Export

- l. Calendar Export
 - m. Trend Export
 - n. Device
4. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.
5. For BACnet devices, provide the following support at a minimum
 - a. Segmentation
 - b. Segmented Request
 - c. Segmented Response
 - d. Application Services
 - e. Read Property
 - f. Read Property Multiple
 - g. Write Property
 - h. Who-has
 - i. I-have
 - j. Who-is
 - k. I-am
 - l. Media Types
 - m. Ethernet
 - n. BACnet IP Annex J
 - o. MSTP
 - p. BACnet Broadcast Management Device (BBMD) function
 - q. Routing

1.27 DDE DEVICE INTEGRATION

- A. The Network Area Controller shall support the integration of device data via Dynamic Data Exchange (DDE), over the Ethernet Network. The Network Area Controller shall act as a DDE client to another software application that functions as a DDE server.
- B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of these devices into the FMCS. Objects provided shall include at a minimum:
 1. DDE Generic AI Object
 2. DDE Generic AO Object
 3. DDE Generic BO Object

4. DDE Generic BI Object

1.28 MODBUS SYSTEM INTEGRATION

- A. The Network Area Controller shall support the integration of device data from Modbus RTU, ASCII, or TCP control system devices. The connection to the Modbus system shall be via an RS-232, RS485, or Ethernet IP as required by the device.
- B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the Modbus system data into the FPMS. Objects provided shall include at a minimum:
 - 1. Read/Write Modbus AI Registers
 - 2. Read/Write Modbus AO Registers
 - 3. Read/Write Modbus BI Registers
 - 4. Read/Write Modbus BO Registers
- C. All scheduling, alarming, logging and global supervisory control functions, of the Modbus system devices, shall be performed by the Network Area Controller.
- D. The FMCS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment utilizing Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning

1.29 GRAPHICAL USER INTERFACE COMPUTER HARDWARE (DESKTOP)

- A. The browser workstation shall be an Intel Dual-Core Intel® Processor based computer (minimum processing speed of 1.86 GHz with 1 GB RAM and a 80-gigabyte minimum SATA hard drive). It shall include a DVD-RW Drive, 1GB Non-ECC DDR2 (1 module), mouse, keyboard, asynchronous serial port, and 2-USB ports. A minimum 17" flat panel color monitor, 1280 x 1024 optimal preset resolution, with a minimum 80HZ refresh rate shall also be included.
- B. Connection to the FMCS network shall be via an Ethernet network interface card, 10/100/1000 Mbps.
- C. A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 60-PPM print speed minimum.
- D. For dedicated alarm printing, provide a dot matrix printer, either 80 or 132 column width. The printer shall have a USB port interface.

1.30 GRAPHICAL USER INTERFACE COMPUTER HARDWARE (LAPTOP COMPUTER)

- A. The laptop computer shall consist, at minimum, of an Intel Dual-Core Intel® Processor based laptop computer (minimum processing speed of 2 GHz with 1 GB RAM and a 80-gigabyte minimum hard drive) and a CD-ROM drive.
- B. Connection to the FMCS network shall be via an Ethernet network interface card, 10/100/1000 Mbps.

1.3 OTHER CONTROL SYSTEM HARDWARE

A. Space Temperature Wall Module: Temperature sensing modules mounted on the wall in occupied spaces. Optional setpoint, indication, and override switches must be provided as specified.

1. Manufacturers: Subject to compliance with requirements. Provide products by one of the manufacturers specified.
 - a. ACI
 - b. Honeywell
 - c. Mamac
 - d. Schneider Electric
 - e. Veris Industries
2. Wall module shall have a thermistor temperature sensor with operating range of 45 to 99 deg. F. under a locking cover/enclosure designed for mounting on a standard electrical switch box.
3. Space temperature sensors shall be accurate to plus or minus 0.5 deg. F at 77 deg. F.
4. Where specified, space temperature sensors shall have a setpoint knob calibrated for warmer-cooler adjustments (*option 1: calibrated to allow plus or minus adjustments to a software setpoint option 2: calibrated to allow absolute setpoint changes*).
5. Where specified, wall module shall also have an after-hours override pushbutton and LED override indicator.
6. Where specified, the wall module shall have a fan coil unit fan control switch for (*auto-off-on*)(*auto-off-low-med-hi*) fan control. The wall module function is further specified in SECTION III Sequence of Operation.
7. Where specified, wall module shall have an LCD display with 2 level user access. Level one access shall be available for typical occupant adjustments, and level two access for system configuration. Level two access shall be accessible only via password or multi-key code input. Room temperature, room temperature setpoint, VAV balancing parameters and settings, occupancy override, and other control parameters for a total of at least 35 items shall be available via the keypad/display. Wall module screens shall be configurable for typical tenant and control contractor views.

B. Duct Mount, Pipe Mount, and Outside Air Temperature Sensors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. ACI
 - b. Honeywell
 - c. Mamac
 - d. Veris Industries
2. Outside air sensors shall include an integral sun shield.
3. Temperature sensors shall have an accuracy of plus or minus 1.0 deg. F. over operating range.

4. Duct sensors shall have sensor approximately in center of the duct, and shall have selectable lengths of 6, 12, and 18 inches.
 5. Multipoint averaging element sensors shall be provided where specified, and shall have a minimum of one foot of sensor length for each square foot of duct area (provide multiple sensors if necessary).
 6. Pipe mount sensors shall have copper, or stainless steel separable wells.
- C. Current Switches: Solid state, split core, current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point shall be provided where specified. Current switches shall include an integral LED for indication of trip condition.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. ACI
 - b. Honeywell
 - c. RIB, Inc.
 - d. Veris Industries
 2. Sensing range 0.5 – 250 Amps.
 3. Output 0.3 A @ 200 VAC/VDC / 0.15 A @ 300 VAC/VDC
 4. Operating frequency 40 Hz -1 kHz.
 5. Operating Temperature 5-104 deg. F (-15 – 40 deg. C), Operating Humidity 0-95% non-condensing
 6. Approvals CE, UL.
- D. Current Sensors: Solid state, split core linear current sensors shall be provided where specified.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. ACI
 - b. Honeywell
 - c. RIB, Inc.
 - d. Veris Industries
 2. Linear output of 0-5 VDC, 0-10 VDC, or 4-20 mA.
 3. Scale sensors so that average operating current is between 20-80% full scale.
 4. Accuracy plus or minus 1.0% (5-100% full scale)
 5. Operating frequency 50-600 Hz.
 6. Operating Temperature 5-104 deg. F (-15 – 40 deg. C), Operating Humidity 0-95% non-condensing
 7. Approvals CE, UL.
- E. Water Flow Meters: Water flow meters shall be axial turbine style flow meters which translate liquid motion into electronic output signals proportional to the flow sensed.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Fluid Components International
 - b. Data Industrial SDI series Meters
 - c. Onicon Meters

2. Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag.
 3. Flow meters shall be ‘insertion’ type complete with ‘hot-tap’ isolation valves to enable sensor removal without water supply system shutdown.
 4. Accuracy shall be $\pm 2\%$ of actual reading from 0.4 to 20 feet per second flow velocities.
- F. Low Temperature Limit Switches. Safety low limit shall be manual reset twenty foot limited fill type responsive to the coolest section of its length. Provided and installed by Mechanical Contractor.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Honeywell
 - b. Johnson Controls
 2. Low Limit Setpoint shall be adjustable between 20 and 60 deg. F. (-5 and 15 deg. C.)
 3. Switch enclosure shall be dustproof and moisture-proof.
 4. Switch shall break control circuit on temperature fall. Contact ratings shall be 10.2 FLA at 120 VAC, and 6.5 FLA at 240 VAC.
 5. Ambient Temperature range -20 to 125 deg. F. (-11 to 52 deg. C.)
 6. Operating Temperature Range 20 to 60 deg. F. (-5 to 15 deg. C.)
- G. High Temperature Limit Switches. Safety high limit (fire stats) shall be manual reset type. Provided and installed by Mechanical Contractor.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Honeywell
 - b. Johnson Controls
 2. High Limit Setpoint shall be adjustable between 100 and 240 deg. F. (38 and 116 deg. C.)
 3. Switch enclosure shall be dustproof and moisture-proof.
 4. Switch shall break control circuit on temperature fall. Contact ratings shall be 10 FLA at 120 VAC, and 5 FLA at 240 VAC.
 5. Ambient Temperature range -20 to 190 deg. F. (-28 to 88 deg. C.) at case, and 350 deg. F (177 deg. C.) at the sensor.
 6. Operating Temperature Range 100 to 240 deg. F. (38 to 116 deg. C.)
- H. CO2 Sensors.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Honeywell
 - b. TelAire
 - c. Vaisala
 2. Carbon Dioxide sensors shall be 0-10 Vdc, 2-10 Vdc, or 4-20 mA linear analog output type, with corrosion free gold-plated non-dispersive infrared sensing, designed for duct or wall mounting.

3. Sensor shall incorporate internal diagnostics for power, sensor, analog output checking, and automatic background calibration algorithm for reduced maintenance. Sensor range shall be 0-2000 PPM with +/- 75 PPM accuracy at full scale.
4. Where specified, sensor shall have an LCD display that displays the sensor reading and status.

I. Differential Pressure Sensors

1. Manufacturers:
 - a. ACI
 - b. Honeywell
 - c. RIB, Inc.
 - d. Veris Industries
2. Sensor shall have four field selectable ranges: 0.1, 0.24, 0.5, 1.0 in w.c. for low pressure models, and 1.0, 2.5, 5, 10 for high pressure models.
3. Sensor shall provide zero calibration via pushbutton or digital input.
4. Sensor shall have field selectable outputs of 0-5 VDC, 0-10 VDC, and 4-20 mA
5. Where specified, sensor shall have and LCD display that displays measured value.
6. Sensor overpressure rating shall be 3 PSID proof, and 5 PSID burst.
7. Sensor accuracy shall be plus or minus 1% FS selected range.

J. Humidity Sensors.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Honeywell
 - b. Johnson Controls
2. Humidity transducer shall be accurate to +/- (**2%, 3%, 5% choose desired accuracy**) between 20-95% RH NIST traceable calibration.
3. Sensors shall have a field selectable output of 0-10 Vdc, 0-5 Vdc, or 4-20 mA.
4. Sensors shall provide field calibration option using non-interacting zero and span potentiometers, and/or toggle switches that increment or decrement the RH value in steps of 0.5% RH.
5. Accuracy of the sensor shall not be adversely affected by condensation.

K. Enthalpy Sensors.

(Option 1 – Changeover type – Select one) Duct mounted enthalpy sensor shall include a temperature sensor and a humidity sensor constructed to close an electrical contact upon a drop in enthalpy (total heat) to enable economizer modes of operation where specified.

(Option 2 – Proportional analog signal– Select one) Provide duct mounted sensor including solid state temperature and humidity sensors with electronics which shall output a 4-20 ma signal input to the controller upon a varying enthalpy (total heat) to enable economizer modes of operation when outside air enthalpy is suitable for free cooling .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Honeywell
 - b. Siemens Building Technologies
 - c. Veris Industries

- L. Annular Pitot Tube Flow Meter. Annular pitot tube shall be averaging type differential pressure sensors with four total head pressure ports and one static port made of austenitic stainless steel.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Air Monitor Corporation
 - b. Ultratech
 - c. Wetmaster Co., Ltd.
 - d. Johnson Controls
 2. Sensor shall have an accuracy of $\pm .25\%$ of full flow and a repeatability of $\pm .05\%$ of measured value.
 3. Transmitter shall be electronic and shall produce a linear output of 0-10 Vdc, 0-5 Vdc, or 4 to 20 mA dc corresponding to the required flow span.
 4. The transmitter shall include non-interacting zero and span adjustments.

- M. Standard Automatic Control Dampers. Provide all automatic control dampers not specified to be integral with other equipment. Provided and installed by Mechanical Contractor. Actuators provided by BAS Contractor.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Greenheck
 - b. Honeywell
 - c. Johnson Controls
 - d. Ruskin
 2. Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the air stream.
 3. Blades shall not be over 8 inches wide or less than 16-gauge galvanized steel triple V type for rigidity.
 4. Bearings shall be acetyl, oilite, nylon or ball-bearing with $\frac{1}{2}$ inch diameter plated steel shafts.
 5. Dampers shall be suitable for temperature ranges of -40 to 180F.
 6. All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.

7. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6". Dampers with dimensions of 24 inches and less shall be rated for 3,000 fpm velocity and shall withstand a maximum system pressure of 5.0 in. w.c. Dampers with dimensions of 36 inches and less shall be rated for 2,500 fpm velocity and shall withstand a maximum system pressure of 4.0 in. w.c. Dampers with dimensions of 48 inches and less shall be rated for 2,000 fpm velocity and shall withstand a maximum system pressure of 2.5 in. w.c. Damper blade width shall be no greater than 8 inches, and dampers over 48 inches wide by 74 inches high shall be sectionalized.
 8. Maximum leakage for dampers in excess of sixteen inches square shall be 30 CFM per square foot at static pressure of 1 inch of WC. Testing and ratings to be in accordance with AMCA Standard 500.
- N. Low Leakage Automatic Control Dampers. Provide all automatic control dampers not specified to be integral with other equipment. Provided and installed by Mechanical Contractor. Actuators provided by BAS Contractor.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Greenheck
 - b. Honeywell
 - c. Johnson Controls
 - d. Ruskin
 2. Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the air stream.
 3. Blades shall not be over 8 inches wide or less than 16-gauge galvanized steel triple V type for rigidity.
 4. Bearings shall be acetyl, oilite, nylon or ball-bearing with ½ inch diameter plated steel shafts.
 5. Dampers shall be suitable for temperature ranges of -40 to 180F.
 6. All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.
 7. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6". Dampers with dimensions of 24 inches and less shall be rated for 3,000 fpm velocity and shall withstand a maximum system pressure of 5.0 in. w.c. Dampers with dimensions of 36 inches and less shall be rated for 2,500 fpm velocity and shall withstand a maximum system pressure of 4.0 in. w.c. Dampers with dimensions of 48 inches and less shall be rated for 2,000 fpm velocity and shall withstand a maximum system pressure of 2.5 in. w.c.
 8. Side seals shall be stainless steel of the tight-seal spring type.
 9. Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage data for all low leakage control dampers with the temperature control submittal.

10. Maximum leakage for low leakage dampers in excess of sixteen inches square shall be 8 CFM per square foot at static pressure of 1 inch of WC.
 11. Low leakage damper blade edges shall be fitted with replaceable, snap-on, inflatable seals to limit damper leakage.
 12. Testing and ratings shall be in accordance with AMCA Standard 500.
 13. Damper blade width shall be no greater than 8 inches, and dampers over 48 inches wide by 74 inches high shall be sectionalized. Testing and ratings to be in accordance with AMCA Standard 500.
- O. Round Motorized Dampers. Round dampers shall be provided where specified and shall be factory mounted in a section of round duct a minimum of 12 inches long, but no less than one inch longer than the duct diameter. Provided and installed by Mechanical Contractor. Actuators provided by BAS Contractor.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Greenheck
 - b. Honeywell
 - c. Johnson Controls
 - d. Ruskin
 2. Duct shall be sleeve type spiral duct crimped on the downstream end, 24 gage galvanized minimum except duct over 12 inches in diameter shall be 22 gage.
 3. Duct shall have an integral galvanized steel actuator mounting plate and a ½ inch zinc-coated steel blade shaft extending a minimum of 2 inches beyond the actuator mounting plate.
 4. Shaft bearings shall be flanged bronze oilite pressed into the frame.
 5. The blade shall be a minimum 16 gage galvanized steel, and damper frame shall be provided with closed-cell neoprene seals with silicone rubber bead. Damper shall be designed for a 2500 ft/min approach velocity and a 4 inch minimum static pressure.
 6. Damper shall be suitable for operation from 32 to 130F temperatures.
 7. Damper and actuator combination shall be designed for leakage rates less than 13 cfm per square foot at one inch w.c. differential and 25 cfm at four inches w.c. Actuator shall have an external declutch lever to allow manual blade positioning during equipment and power malfunctions.
- P. Control Valves: (*Globe Type*) Control valves shall be 2-way or 3-way pattern as shown constructed for tight shutoff and shall operate satisfactory against system pressures and differentials.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Honeywell
 - b. Belimo
 - c. Schneider Electric
 2. Two-position valves shall be line size.

3. Proportional control valves shall be sized for a nominal pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Manufacturer's specified maximum differential pressure shall not be exceeded in order to prevent cavitation.
 4. Two-way proportional valves shall have equal percentage flow characteristics. Three-way valves shall have equal percentage flow characteristics straight through, and linear through the bypass. Rangeability shall be 50:1 or greater.
 5. Provide valve position indicator and a method to operate valves manually during system start-up, or actuator power loss or failure on all valves.
 6. Leakage rate shall be no more than ANSI Class III (for heating) or ANSI Class IV (for cooling).
 7. Valves 1/2 inch through 3 inches shall be screwed pattern except where solder connections are specified for valves 1/2 or 3/4 inches.
 8. Three-way valve bypass ports shall be of Cv to provide constant flow through the control loop.
 9. Two-way valves shall close off against the net differential pressure resulting from the maximum head pressure of the system pumps less all loop pressure losses. Three-way valves shall close off against the difference in head pressure between the controlled load and the bypass line.
 10. Valves 2-1/2 inch and larger shall be flanged and ANSI/ASME-rated to withstand the pressures and temperatures specified.
 11. Valves shall have stainless-steel stems and spring loaded Teflon packing with replaceable discs.
- Q. Control Valves: (**Characterized Ball Valves**) Control valves 1/2 to 3 inches shall be 2-way or 3-way forged brass screwed pattern constructed for tight shutoff and shall operate satisfactory against system pressures and differentials.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Honeywell
 - b. Belimo
 2. Two-position valves shall be line size.
 3. Proportional control valves shall be sized for a nominal pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Manufacturer's specified maximum differential pressure shall not be exceeded in order to prevent cavitation.
 4. Two-way proportional valves shall have equal percentage flow characteristics. Three-way valves shall have equal percentage flow characteristics straight through and linear flow through the bypass.
 5. Leakage rate shall be ANSI Class IV (no more than 0.01% of Cv).
 6. Fluid temperature range shall be between -22 and +250 degrees F. water or glycol solutions up to 50%. Piping and valves shall be properly insulated to prevent formation of ice on moving parts.
 7. Valves shall be rated for no less than 360 psig at 250 degrees F.

8. Provide a method to operate valves manually during system start-up, or actuator power loss or failure on all valves.
 9. Two-way valves shall close off against 70 psi minimum, and three-way valves shall close off against 40 psi minimum.
 10. Valves shall have stainless-steel or chemically nickel-plated brass stem and throttling port.
 11. Actuator shall be available with NEMA 3R (IP54) rated enclosure suitable for outdoor installation.
 12. Valves shall be tagged with Cv rating and model number.
- R. Control Valves: (*Characterized Ball Valves*) Control valves 4 to 6 inches shall be 2-way or 3-way cast iron ANSI Class 125 flanged connections as shown constructed for tight shutoff and shall operate satisfactory against system pressures and differentials.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Honeywell
 - b. Belimo
 2. Two-position valves shall be line size.
 3. Proportional control valves shall be sized for a nominal pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Manufacturer's maximum differential pressure shall not be exceeded in order to prevent cavitation.
 4. Two-way water valves shall have equal percentage flow characteristics. Three-way valves shall have equal percentage flow characteristics straight through and linear with 20% reduced flow through the bypass. Rangeability shall be 100:1 or greater.
 5. A-port leakage rate shall be ANSI Class IV (no more than 0.01% of Cv) or better.
 6. Fluid temperature range shall be between -22 and +250 degrees F. water or glycol solutions up to 50%. Piping and valves shall be properly insulated to prevent formation of ice on moving parts.
 7. Valves shall be rated for no less than 240 psig at 250 degrees F.
 8. Provide a method to operate valves manually during actuator power loss or failure.
 9. Two-way valves shall close off against 70 psi minimum, and three-way valves shall close off against 40 psi minimum.
 10. Valve ball and stem shall be 316 stainless-steel.
 11. Actuator shall be available with NEMA 3R (IP54) rated enclosure suitable for outdoor installation.
 12. Valves shall be tagged with Cv rating and model number.
- S. Butterfly Control Valves: Where specified, butterfly control valves 2" to 20" in size shall be cast iron body type for 2-way applications and constructed for tight shutoff and shall

operate satisfactorily against system pressures and differentials. Three-way applications shall consist of 2-way valves assembled to a "Tee" fitting with common actuators and operating linkage.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Bray
 - b. Honeywell
 - c. Belimo
 - d. Tyco International
 2. Valves shall have tapped lugs for standard flange connection, and meet ANSI/ASME requirements to withstand the pressures and temperatures encountered.
 3. Valve shall have a corrosion, ultra-violet, and wear-resistant coating for outdoor applications.
 4. Resilient-seated valves shall use food-grade elastomeric seats. Seat shall also function as the flange gaskets.
 5. Valves shall be designed for isolation and the absence of downstream piping at rated differential pressure.
 6. All valves shall be line size.
 7. Proportional control valves shall be sized for a nominal pressure drop of 5.0 psid at rated flow (except as may be noted on the drawings) up to a maximum stroke of 60° disk rotation. Manufacturer's maximum fluid velocity shall not be exceeded in order to prevent cavitation.
 8. Valves shall be rated for bubble tight shutoff at no less than 150 psi differential pressure for full cut valves, or 50 psi for under cut valves.
 9. Valve disc shall be of corrosion-resistant construction appropriate for the controlled media such as nylon-coated cast iron, aluminum bronze, or stainless steel.
 10. Valve stems shall be stainless steel, with inboard top and bottom bearings, and an external corrosion resistant top bearing to absorb actuator side thrust.
 11. Actuator mounting flange shall conform to ISO 5211 for actuator interchangeability.
 12. Actuator shall be available with NEMA 4X (IP65) rated enclosure suitable for outdoor installation.
 13. Valves shall be tagged with Cv rating and model number.
- T. Variable Frequency Drives.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. ABB
 - b. Honeywell
 2. Variable frequency drives shall be UL listed and sized for the power and loads applied.

3. Drives shall include built-in radio frequency interference (RFI) filters and be constructed to operate in equipment rooms and shall not be susceptible to electromagnetic disturbances typically encountered in such environments. Similarly, the drives must not excessively disturb the environment within which it is used.
4. All VFDs over 3 horsepower shall be provided with an AC choke.
5. VFDs shall be installed in strict conformance to the manufacturer’s installation instructions, and shall be rated to operate over a temperature range of 14 to 104 F.
6. VFD automatic operation shall be suitable for an analog input signal compatible with the digital controller output.
7. Each VFD shall be fan cooled and have an integral keypad and alphanumeric display unit for user interface. The display shall indicate VFD status (RUN motor rotation, READY, STOP, ALARM, and FAULT), and shall indicate the VFD current control source (DDC input signal, keypad, or field bus control). In addition to the alphanumeric display, the display unit shall have three pilot lights to annunciate when the power is on (green), when the drive is running (green, blinks when stopping and ramping down), and when the drive was shut down due to a detected fault (red, fault condition presented on the alphanumeric display).
8. Three types of faults shall be monitored, “FAULT” shall shut the motor down, “FAULT Auto-reset” shall shut the motor down and try to restart it for a programmable number of tries, and “FAULT Trip” shall shut the motor down after a FAULT Auto-reset fails to restart the motor. Coded faults shall be automatically displayed for the following faults:
 - Over current
 - Over voltage
 - Earth ground
 - Emergency stop
 - System (component failure)
 - Under voltage
 - Phase missing
 - Heat sink under temperature
 - Heat sink over temperature
 - Motor stalled
 - Motor over temperature
 - Motor under load
 - Cooling fan failure
 - Inverter bridge over temperature
 - Analog input control under current
 - Keypad failure
 - Other product unique monitored conditions
9. In addition to annunciating faults, at the time of fault occurrence the VFD shall capture and make available to the user certain system data for subsequent analysis during fault trouble shooting, including duration of operation (days, hours, minutes, seconds), output frequency, motor current, motor voltage, motor power, motor torque, DC voltage, unit temperature, run status, rotation direction, and any warnings. The last 30 fault occurrences shall be retained as well as the fault data listed in the previous sentence of each fault. New faults beyond 30 shall overwrite the oldest faults.

10. The display unit keypad shall allow setting operational parameters including minimum and maximum frequency, and acceleration and deceleration times. The display shall offer user monitoring of frequency, unit temperature, motor speed, current, torque, power, voltage, and temperature.
- U. **Actuators, General.** All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close-off. Valves shall be provided with actuators suitable for floating or analog signal control as required to match the controller output. Actuators shall be power failure return type where valves or dampers are required to fail to a safe position and where specified.
- V. **Non-Spring Return Low Torque Direct Coupled 35 & 70 lb-in Actuators.** Actuators shall be 35 or 70 lb-in. with strokes adjustable for 45, 60, or 90 degree rotation applications and designed for operation between 20 and 125 F.
 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Honeywell
 - b. Belimo
 2. Each actuator shall also have a minimum position adjustable rotation of 0 to 30 degrees.
 3. Actuators shall be for floating or two position (ML 6161 or ML6174) control, or for 4-20 mA or 2-10Vdc (ML7161 or ML7174) input signals.
 4. Analog control actuators shall have a cover mounted direct/reverse acting switch.
 5. Actuator motor shall be magnetically coupled or shall have limit switch stops to disengage power at the ends of the stroke.
 6. Actuators shall be direct connected (no linkages) and provided with a manual declutch for manual positioning.
 7. Actuators shall have NEMA 1 environmental protection rating and be 24 volt and UL listed with UL94-5V plenum requirement compliance.
 8. Minimum design life of actuators shall be for 1,500,000 repositions and 35 lb-in. models shall be designed for 50,000 open-close cycles and 70 lb-in. models shall be designed for 40,000 open-close cycles.
 9. Actuator options shall include 1) Auxiliary feedback potentiometers, 2) open-closed indicator switches, 3) actuator timings of 90 seconds, 3 minutes, or 7 minutes, one or two auxiliary switches, and 4) torque of 35 or 70 lb-in.
- W. **Non-Spring Return High Torque 177 and 300 lb-in Actuators.** Actuators shall be UL listed 24 Vac in NEMA 2 enclosures designed for operation between -5 and 140 F.
 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Honeywell
 - b. Belimo
 2. Rotation direction shall be switch selectable.

3. Minimum design life of actuators shall be for 1,500,000 repositions and for 60,000 open-close cycles.
4. Actuators shall be suitable for the controller output signals encountered, floating or analog, and shall have full cycle timing of 95 seconds.
5. Actuators shall be direct connected (no linkages) and provided with a manual declutch for manual positioning.

(Select one or more of the following descriptions required)

- Actuators shall have 300 lb-in. torque.
- Actuators shall have 177 lb-in. torque with adjustable stroke, 30 to 90 degrees.
- Actuators shall have 177 lb-in. torque with adjustable stroke, 30 to 90 degrees, and shall auxiliary end switches to annunciate full open and full closed positions.

X. Spring Return Direct Coupled Actuators. Actuators shall have torque ratings of 44lb-in., 88 lb-in., or 175 lb-in. Actuators shall be modulating 90 seconds nominal timing or two-position 45 seconds nominal timing types with strokes for 90 degree rotation applications and designed for operation between -40 and 140 F.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Honeywell
 - b. Belimo
2. Each torque rating group shall have optionally selected control types, floating control, 2-position 24 Vac, 2-position line voltage, or analog input which is switch selectable as 0-10Vdc, 10-0 Vdc, 2-10 Vdc, or 10-2 Vdc.
3. Actuator spring return direction (open or closed) shall be easily reversed in the field, and actuators shall spring return in no greater than 20 seconds.
4. Actuators shall be direct connected (no linkages), and shall have integral position indication.
5. Actuators shall have NEMA 2 environmental protection rating, and UL approved and plenum rated per UL873.
6. Minimum design life of modulating actuators shall be for 1,500,000 repositions and 60,000 spring returns, except 2-position actuators shall be for 50,000 spring returns.
7. Each actuator shall be provided with a manual power-off positioning lever for manual positioning during power loss or system malfunctions, including a gear-train lock to prevent spring action.
8. Upon power restoration after gear lock, normal operation shall automatically recur.

Y. Fast Acting Two Position Fire & Smoke Actuators. Fire/smoke damper actuators shall be direct connected (no linkages) two-position spring return types with stroke for 90 degree nominal rotation applications and designed for 60,000 full stroke cycles and normal operation between 0 and 130 F. Provided by Mechanical Contractor.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - a. Honeywell
 - b. Belimo
 2. Actuators control shall be compatible with SPST control switch and with torque ratings of 30 lb-in.
 3. Actuator timing shall be 25 seconds maximum in powered instances and shall spring-return in 15 seconds.
 4. Actuators shall be UL listed with UL873 plenum rating with die-cast aluminum housing with integral junction box and conduit knockouts, and designed to operate reliably in smoke control systems requiring UL555S ratings up to 350F.
 5. The actuator shall be designed to operate for 30 minutes during a one-time excursion to 350F.
 6. Actuator shall require no special cycling during long-term holding, and shall “hold” with no audible noise at a power consumption of approximately half of the driving power.
 7. Actuators shall be 24 volt or 120 volt with models for clockwise (add a B suffix) and counter-clockwise (add an A suffix) spring return.
- Z. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. Control panels shall meet all requirements of Title 24, California Administrative Code. Provide engraved phenolic nameplates identifying all devices mounted on the face of control panels. A complete set of ‘as-built’ control drawings (relating to the controls within that panel) shall be furnished within each control panel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All work described in this section shall be performed by authorized Honeywell system integrators or contractors that have a successful history in the design and installation of integrated control systems. The installing office shall have a minimum of five years of integration experience and shall provide documentation if requested in the submittal package verifying the company's experience.
- B. Install system and materials in accordance with manufacturer’s instructions, and as detailed on the project drawing set.
- C. Drawings of the TCS and FMCS network are diagrammatic only and any apparatus not shown, but required to make the system operative to the complete satisfaction of the Architect shall be furnished and installed without additional cost.
- D. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by this contractor in accordance with these specifications.

- E. Equipment furnished by the HVAC Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by this contractor.

3.2 WIRING

- A. All electrical control wiring and power wiring to the control panels, NAC, computers and network components shall be the responsibility of the this contractor. Any condenser wire for split systems/heat pumps (run between indoor and outdoor unit) to be provided and installed by mechanical contractor.
- B. The electrical contractor (Div. 16) shall furnish all power wiring (>24V) to controllers, electrical starters, and motors. Power for controls are shown roughed in on electrical drawings. The electrical contractor is responsible for running 120 volt wiring from this source to all locations requiring 120 volt power for the control system
- C. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All FMCS wiring shall be installed in the conduit types specified in the Project Electrical Specifications (Division 16) unless otherwise allowed by the National Electrical Code or applicable local codes. Where FMCS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

3.3 WARRANTY

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this contractor at no expense to the Owner

3.4 WARRANTY ACCESS

- A. The Owner shall grant to this contractor, reasonable access to the TCS and FMCS during the warranty period.
- B. The owner shall allow the contractor to access the TCS and FMCS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

3.5 ACCEPTANCE TESTING

- A. Upon completion of the installation, this contractor shall load all system software and start-up the system. This contractor shall perform all necessary calibration, testing and debugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.
- B. This contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

- C. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.
- D. System Acceptance: Satisfactory completion is when this contractor and the Division 16 contractor have performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.6 OPERATOR INSTRUCTION, TRAINING

- A. During system commissioning and at such time acceptable performance of the TCS and FMCS hardware and software has been established this contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.
- B. This contractor shall provide 40 hours of instruction to the owner's designated personnel on the operation of the TCS and FMCS and describe its intended use with respect to the programmed functions specified. Operator orientation of the systems shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.
- C. The training shall be in three sessions as follows:
 - 1. Initial Training: One day session (8 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.
 - 2. First Follow-Up Training: Two days (16 hours total) approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.
 - 3. Warranty Follow Up: Two days (16 hours total) in no less than 4 hour increments, to be scheduled at the request of the owner during the one year warranty period. These sessions shall cover topics as requested by the owner such as; how to add additional points, create and gather data for trends, graphic screen generation or modification of control routines.

SECTION 23 09 93 - SEQUENCES OF OPERATION FOR HVAC CONTROLS

GENERAL:

- The BAS contractor shall provide all points listed under “Equipment Control Points” as well as any points required to accomplish the sequences of operation listed below. Refer to Specification 23 09 23 for input/output device specifications. Refer to contract drawings for additional items that may not be included in this specification. At the 11 month walk-thru, BAS contractor shall provide an additional DDC demonstration (in addition to the demonstration before substantial completion).
- Building automation systems sub-contractor shall provide and install step down transformers in each mechanical room and run low voltage communication wiring power loops to serve low voltage actuators installed at each Air Terminal Unit serving electrical rooms.
- All BAS exposed control wiring below the ceiling and especially outdoors (rigid) shall be in conduit; furnished and installed by bas subcontractor.
- No portion of the total contract will be declared substantially complete until the graphics and automatic temperature control system has been demonstrated to be complete and functioning as intended. The BAS system will be complete and functioning as intended when all of the space temperatures are maintained at plus or minus two degrees of set point.
- BAS shall BACnet interface to all chillers, boilers, VFDs, utility meters, and equipment provided with on-board controls. Utility meters to be provided by controls contractor. See schedule on mechanical plans.
- Equipment provider must provide a certified controls start-up technician in order to assist with integration. This includes but is not limited to the following:
 - Inputting the device address, MAC address or IP address. (If equipment is to be BACnet/IP the equipment manufacturer shall be responsible for making sure the equipment points are pulled into customers network)
 - Ensuring appropriate points mapped and enabled. Assistance with pulling in points onsite is to be included for ALL equipment with on-board controls. Equipment controls technician is to be onsite with BAS Controls tech.
 - Equipment point Read/write option selection as needed.
 - All points pulled into onboard controller are reading properly through on-board controller and through the BAS interface, with points matching.
 - BACnet Priority levels are not holding out commands from BAS.
 - The controls contractor is not responsible if there is a differentiation in how the on-board controls are programmed compared to the design SOO.
 - Remote technical assistance is not to be the BAS controls responsibility in order to troubleshoot and diagnose control through BACnet
- Controller manufacturer for BACnet controlled equipment must provide onsite dedicated resources for the setup of the integration to BMS.

- Equipment manufacturer for BACnet controlled equipment must provide onsite dedicated resources for the setup of the integration to BMS.
- Division 26 contractor shall supply dedicated 120vac power to a junction box in each mechanical room for use by the BAS. Coordinate with Div 26 contractor on number of circuits required prior to bid.
- BAS contractor shall perform site visits of each and every building prior to bid date and thoroughly investigate all existing HVAC equipment to remain but scheduled for full DDC upgrade. BAS contractor shall also take inventory of existing BAS equipment and devices in order to determine what is to be removed, replaced, or upgraded. Failure to do so will be at BAS subcontractor's cost and not the owner or engineer.
- BAS shall remove existing and provide and install new modulating control valves and actuators at all existing to remain units.
- BAS shall remove existing and provide and install new modulating dampers and actuators at all existing to remain units / ductwork.
- BAS subcontractor shall be responsible for all BAS related demolition.
- All equipment and wiring, including panels, controllers, auxiliary control devices and sensors, communication wire, and I/O wire shall be provided new. No existing or re-manufactured parts shall be re-used.
- Provide completely new DDC controls upgrade for all existing equipment as scheduled and shown on plans and / or specifications. Existing controllers, control wiring, control cabinets, sensing devices, control valve and damper actuators, etc. shall be brand new and shall not reused.
- BAS contractor shall demo and remove all existing controllers, sensing devices, control valve body and associated actuators damper actuators, control cabinet enclosures, pneumatic tubing, raceways, control air compressor, refrigerated air dryer, etc. No controls equipment shall be abandoned in place. No existing BAS controllers, end devices, control cabinets, etc. shall be re-used. Demo all BAS related components and provide new.
- All HVAC equipment including but not limited to: air handling units, fan coil units, rooftop units, computer room units, exhaust fans, etc. not scheduled for demolition shall have BAS upgraded using at a **minimum point-to-point replacement** of existing equipment (if not listed in the sequences). New devices are required to meet specified control sequences. Proper controls for equipment that is currently being monitored or enabled are to include added devices and wiring in order to include fully control.
- Exhaust fans, relief hoods, outside air intake hoods, etc. shall be provided with new control damper and actuators. If dampers and actuators do not exist for exhaust fans (roof or in-line), outside air intakes, and relief hoods, contractor to provide and install new dampers with actuators and necessary power feeds.
- Provide new front-end system, system architecture, etc. with new thermographics illustrating current floor plan with current room names.

1. SINGLE DUCT VAV AIR HANDLING UNITS WITH DEMAND CONTROL VENTILATION

Equipment Control Points

Supply air temperature – AI
Discharge air temperature (each coil) – AI
Supply air duct static pressure – AI
Fan status – DI
High Static pressure limit – DI
Fan start/stop – DO
Fan speed control – AO
Chilled water valve control – AO
Heating KW – AO (SCR Control)
OA damper with end switch – DO
Freeze stat – DI

AHU Activation

Each Single Duct variable air volume air handler shall be activated by a time-of-day schedule and shall broadcast an occupancy command to the associated terminal units.

Fan Control

When the air handler is scheduled to run, the B.A.S. controller will send signal to the air handler inverter, which will energize the fan. A current switch will prove status to the Building Automation System (BAS) and alarm the central site if the switch is not made within 20 seconds (operator adjustable). There will also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms from a bouncing switch. A run request will be sent to the Chilled Water System when the air-handling unit is active, and cooling is required.

Temperature Control

When the air handling unit is in occupied mode and cooling is required, the BAS shall send a request for cooling to the chiller plant and shall modulate the chilled water control valve to maintain leaving air temperature setpoint (55 °F, adjustable). The BAS shall have the ability to reset the leaving air temperature based on cooling request. When there are no cooling requests, the leaving air temperature setpoint shall reset up to a maximum of 58 °F (adjustable). When 2 (adjustable) or more cooling requests are present, the leaving air temperature setpoint shall reset down to 52 °F (adjustable). The reset shall not exceed more than 0.2 °F (adjustable) every 3 minutes (adjustable).

When the air handling unit is active, and heating is required a duct mounted temperature sensor mounted downstream of the preheat coil shall modulate the heating element to maintain discharge air temperature setpoint of 55°F (adjustable).

Air Volume Control

While the air handling unit is active, the BAS shall maintain the duct static pressure setpoint at 1.5" w.g. (adjustable, final setpoint to be determined by TAB contractor) by modulating the speed of the supply fan through a variable speed drive (VSD). A static pressure sensor mounted two-thirds down the longest duct run shall monitor the duct static pressure. A manual-reset static pressure high limit switch shall monitor the static pressure of the supply duct. If the duct static pressure rises above 3.0" w.g. (locally adjustable) the air handling unit shall be de-energized via hard-wire interlock to the VFD safety circuit. The BAS shall monitor the high static limit switch and shall display an alarm at the central site. The static pressure high limit switch must be manually reset.

The static pressure shall reset to achieve a target damper setpoint of 85% with a 5% dead-band. Static pressure shall reset by not more than 0.2" W.C. every 3 minutes. Static pressure shall be a minimum of 0.5" W.C.

Demand Control Ventilation

When the air handler is running in the occupied mode, the O.A. damper control shall be enabled and a request to run shall be sent to the OAHU that supplies the unit with outside air. A CO₂ sensor mounted in various spaces (see series fan powered box sequence) shall monitor the CO₂ level in the spaces. The B.A.S. shall select the highest level or average (user adjustable from settings page) to modulate the OA damper. The B.A.S. shall modulate the outdoor air damper from its minimum position to its maximum position as required to maintain the CO₂ level at between 850 ppm and 1,000 ppm (all adjustable). The OA dampers minimum and maximum positions shall be determined with the T.A.B. contractor to be the positions that allow the scheduled minimum and maximum OA CFM.

The outside air damper shall remain closed, and the OAHU shall remain off even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule.

Unoccupied Control

The AHU shall monitor the space temperature sensors and give the ability to select the high/low or average of the accumulation. If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F (adjustable) heating and 95°F (adjustable) cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints. All values are operator adjustable.

Associated Equipment

During the occupied time period, a request to run shall be sent to the corresponding exhaust fans and OAHU. The exhaust fans associated with the air handler shall be energized only during the occupied time period. The OAHU's & exhaust fans shall remain off, even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on an outdoor air shutdown schedule.

Equipment off Conditions

When the air handling unit is de-energized, the cooling valve shall be closed, the outside air damper shall be closed, and any associated exhaust fans shall be de-energized.

Freeze Protection

A manual reset freeze stat shall be mounted in the discharge air stream of the heating coil. The normally closed contacts of the switch shall be wired in series with the VSD safety interlock circuit so that, when activated, the VSD will shut down the fan. Upon sensing a low limit condition, the BAS shall open the HW and CHW control valves, close the outdoor air damper, energize the hot water pump and boiler (see heating water sequence of operation), and alarm at the central site.

2. SINGLE ZONE VAV AIR HANDLING UNITS WITH HUMIDITY CONTROL

Equipment Control Points

Space temperature – AI
Space humidity – AI
Discharge CHW coil air temperature – AI
Discharge reheat HW coil air temperature – AI
Discharge preheat HW coil air temperature – AI
Fan status – DI
Air Handling Unit Fan start/stop – DO
Fan speed control – AO
Chilled water valve control – AO
Re-Heating KW – AO (SCR Control)
Pre-Heating KW – AO (SCR Control)

OA damper with end switch – DO
Freeze stat – DI

AHU Activation

The air-handling unit shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature versus the occupied heating or cooling setpoint, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site. The air-handling unit control program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Fan Control

When the air handler is requested to run, the B.A.S. control module shall send an enable signal to the air handler inverter, which will energize the fan. A current switch shall prove status to the Building Automation System (BAS) and alarm the central site if the switch is not made within 20 seconds (operator adjustable). There shall also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms. A run request shall be sent to the Chilled Water System when the air-handling unit is active, and cooling is required. A run request shall be sent to the Heating Water System when the air-handling unit is active, and heating is required. As the zone temperature rises, the fan will modulate from its minimum speed (determined by the TAB contractor) to its maximum speed. As the zone temperature falls below the heating setpoint the fan will run at a fixed speed (determined by the TAB contractor) and the hot water valve will modulate to maintain the space heating temperature setpoint.

Temperature Control

A wall mounted space temperature sensor shall monitor the air temperature in the space. The B.A.S. shall output separate signals to modulate the chilled water and heating water control valve actuators in sequence to maintain the space temperature within its operator adjustable heating and cooling setpoints. As the zone temperature rises, the fan will modulate from its minimum speed (determined by the TAB contractor) to its maximum speed. As the zone temperature falls below the heating setpoint the fan will run at a fixed speed (determined by the TAB contractor) and the hot water valve will modulate to maintain the space heating temperature setpoint.

When the air handling unit is active, and heating is required a duct mounted temperature sensor mounted downstream of the preheat coil shall modulate the heating element to maintain discharge air temperature setpoint of 55°F (adjustable).

Space Humidity Control

A space humidity sensor, monitored by the B.A.S., shall set the cooling coil discharge air setpoint to 55°F (adjustable) and modulate the chilled water valve to maintain the setpoint if the humidity rises above 60% (adjustable) and continue until it falls by 5% (adjustable). The B.A.S. shall modulate the heating element to maintain the space temperature between its heating and cooling setpoints. The fan will run at a fixed speed (determined by the TAB contractor or at 30%) while in dehumidification mode.

Unoccupied Control

If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F (adjustable) heating and 95°F (adjustable) cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints. All values are operator adjustable.

Associated Equipment

During the occupied time period, the outside air damper shall be open. The exhaust fans associated with the air handler shall also be energized only during the occupied time period. The outside air dampers shall remain closed, the exhaust fans shall remain off, even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on an outdoor air shutdown schedule. The Exhaust fans shall be commanded (off) during

morning cool down / warm up and shall only turn on during the occupied time periods. General exhaust fans may require a separate schedule to accomplish this sequence and will be part of the commissioning sequence of operations to be demonstrated.

Equipment off Conditions

When the air-handling unit is de-energized, its chilled water valve, hot water valve and OA damper shall be closed. The related exhaust fans shall be de-energized and the request to run to the OAHU shall be canceled. While the units are off if the outside air temperature falls below 34°F (operator adjustable) the chilled water valve and hot water valves shall be opened to 20% (adjustable) and the secondary pumps shall run for freeze protection.

Freeze Protection

A manual reset freeze stat shall be mounted in the discharge air stream of the heating coil. The normally closed contacts of the switch shall be wired in series with the VSD safety interlock circuit so that, when activated, the VSD will shut down the fan. Upon sensing a low limit condition, the BAS shall open the HW and CHW control valves, close the outdoor air damper, energize the hot water pump and boiler (see heating water sequence of operation), and alarm at the central site.

3. SERIES FAN POWERED AIR TERMINAL UNIT – WITH ELECTRIC HEAT

Equipment Control Points

Space temperature – AI
Discharge temperature - AI
Cold deck flow – AI
Fan Start/stop – DO
Fan Status - DI
Cooling damper – FM
Electric Heat (SCR Control) – AO

Zone Occupancy

The parent AHU shall have an occupancy schedule assigned to it. Upon occupancy the AHU shall broadcast an occupancy signal to the terminal unit,

When the CVB Boxes calculated start, time arrives its internal fan motor shall be energized and continue to run until the unoccupied period arrives.

Temperature Control

When the zone becomes active, the CVB controller shall determine, based on the space temperature, whether heating or cooling is required. If cooling is required, the cooling air damper shall be modulated open to its operator adjustable maximum cooling CFM setpoint and cool request shall be sent to the air handling unit serving the CVB. As the space temperature returns to setpoint, the CVB cooling air damper shall modulate to its operator adjustable minimum cooling CFM setpoint.

The cooling damper actuator shall use a stepper motor so its position can be accurately tracked for display on the CVB graphic and collected by the air-handling unit serving the CVB to reset the air handling unit static pressure setpoint.

During heating mode, the CVB terminal damper will be maintained at its adjustable minimum heating CFM setpoint, and the heating element shall maintain the space temperature.

Unoccupied Control

During the unoccupied time period, the CVB cooling damper shall be open (operator adjustable) and its fan shall be de-energized. If the space temperature reaches the operator adjustable unoccupied setpoints of 55°F heating and 95°F cooling, the required equipment shall be started and run to maintain the space temperature within the setpoints.

4. SINGLE ZONE VAV AIR HANDLING UNIT WITH ENERGY RECOVERY WHEEL

Equipment Control Points

Space temperature – AI
Space humidity – AI
Space CO2 level(s) – AI (combo space, humidity and CO2 is acceptable)
Discharge air temperature – AI
Discharge cooling coil air temperature – AI
Discharge heat heating coil air temperature – AI
Wheel Outside Air leaving temperature – AI
Wheel Outside Air entering temperature – AI
Wheel Exhaust leaving air temperature – AI
Wheel Exhaust entering air temperature – AI
Outside air flow – AI
Exhaust air flow – AI
Supply fan status – current switch – DI
Exhaust fan status – current switch – DI
Supply Fan start/stop – DO
Exhaust fan start/stop – DO
Energy recovery wheel start/stop - DO
DX cooling stages - DO (quantity to match AHU)
Heating KW – AO (SCR Control)
Supply fan speed control – AO
Exhaust fan speed control – AO
Energy Recovery wheel control - AO
Outdoor air damper, with end switch – DO / DI
Exhaust damper with end switch – DO / DI

Unit Activation

The air-handling unit shall have an occupancy/vacancy schedule, occupied heating/cooling setpoints and unoccupied heating/cooling setpoints assigned to it. As the occupancy time approaches, an optimum start/stop program shall calculate a start time based on current space temperature verses the occupied heating or cooling setpoint, assigned recovery rate, and outside air temperature -- all variables are operator assignable from the central site. The air-handling unit control program shall have the ability to learn its recovery rate whenever the operator enables the learning feature.

Fan Control

When the air handler is requested to run, the BAS controller will send a signal to the outside air damper and exhaust air damper to open. Upon receiving a signal from both damper end switches, the respective fans shall be commanded to run. A current switch on each fan will prove status to the BAS and alarm the central site if either switch is not made within 20 seconds (operator adjustable). There will also be a 10 second (operator adjustable) de-bounce time to prevent nuisance alarms.

The AHU fan and exhaust fan ramp speeds shall be configured in the VFD drive, by the start-up unit manufacturer and set to ensure that it takes no less than 3 minutes for the unit fans to ramp to the controlled setpoints.

Temperature Control

A wall mounted space temperature sensor shall monitor the air temperature in the space. The B.A.S. shall output separate signals to modulate the dx cooling and heating element in sequence to maintain the space temperature within its operator adjustable heating and cooling setpoints. As the zone temperature rises, the fan will modulate from its minimum speed (determined by the TAB contractor) to its maximum speed. As the zone temperature falls below the heating setpoint the fan will run at a

fixed speed (determined by the TAB contractor) and the heating element will maintain the space heating temperature setpoint.

The EF VFD shall ramp in sequence with the SF VFD. The offset and speeds shall be set by the TAB contractor to insure the design flow CFMs are met.

Demand Control Ventilation

When the air handler is running in the occupied mode, the O.A. damper control shall open. A CO₂ sensor mounted in the space shall monitor the CO₂ level in the spaces. The B.A.S. shall modulate the outdoor air damper from its minimum position to its maximum position as required to maintain the CO₂ level at between 850 ppm and 1,000 ppm (all adjustable). The OA dampers minimum and maximum positions shall be determined with the T.A.B. contractor to be the positions that allow the scheduled minimum and maximum OA CFM.

The outside air damper shall remain closed, even during a scheduled occupancy time based on a global command from a shelter in place (building shutdown) button activation or based on a summer mode schedule.

Space Humidity Control

A space humidity sensor, monitored by the B.A.S., shall set the cooling coil discharge air setpoint to 55°F (adjustable) and modulate the dx cooling to maintain the setpoint if the humidity rises above 60% (adjustable) and continue until it falls by 5% (adjustable). The B.A.S. shall modulate the heating element to maintain the space temperature between its heating and cooling setpoints. The fan will run at a fixed speed (determined by the TAB contractor or at 30%) while in dehumidification mode.

Energy Recovery Wheel

When the air handler is in occupied mode, the energy recovery wheel shall be started.

When the outside air entering temperature is greater than the exhaust air entering temperature, the wheel shall operate in cooling mode at its full effectiveness and maximum speed of 20 RPM.

When the outside air entering temperature reaches frost control setpoint, 34°F (adjustable), the wheel's speed shall be modulated to avoid ice formation within the wheel's media.

When outside air entering temperature is lower than the exhaust air entering temperature, but supply air temperature reaches the free cooling setpoint, 60°F (adjustable), the wheel's speed shall be modulated to prevent the supply air from exceeding the free cooling setpoint.

When outside air entering temperature is lower than the exhaust air entering temperature; when the outside air entering temperature is above the frost setpoint, 34°F (adjustable), and supply air temperature is below the free cooling setpoint, 60°F (adjustable), the wheel shall operate in heating mode at its full effectiveness and maximum speed of 20 RPM.

Equipment off Conditions

When the outdoor air-handling unit is off, its chilled and heating water valves shall be closed, the outdoor air damper shall also be closed, supply and exhaust fans shall be de-energized, and the return air damper shall be fully open. If the outside air temperature drops below 34°F (operator adjustable), the BAS shall open the chilled water valve to 50% (adjustable), the hot water control valve to 30% (adjustable), and a signal shall be sent to the plant to run for freeze protection.

5. DUCTLESS MINI-SPLIT A/C UNITS

Equipment Control Points

Room temperature - AI
Unit alarm - DI

A split-system cooling unit coil shall be controlled by a microprocessor temperature sensor/controller, furnished by the unit manufacturer. The controller shall monitor the air temperature in the space. The thermostat shall energize cooling to maintain room setpoint. The BAS shall monitor the room temperature and alarm at the central site if the temperature rises above 85°F (adjustable).

6. EXHAUST FAN ON T-STAT CONTROL

Equipment Control Points

Space temperature - AI
Fan status – DI
Fan start/stop – DO

The BAS shall start/stop the exhaust fan to maintain a space temperature of 80°F (adjustable) during occupied and unoccupied modes.

7. GENERAL EXHAUST FANS

Equipment Control Points

Exhaust fan status – Current switch - DI
Exhaust fan enable – DO

Interlock all general exhaust fans to run only during the occupied mode. The exhaust fans shall remain off even during the scheduled occupancy time based on a global command from a shelter in place (building shutdown) button. Exhaust fans shall have motorized dampers and actuators provided by fan manufacturer, wired and installed by BAS contractor and necessary interlock wiring to allow damper to open whenever the exhaust fan is running.

8. OUTDOOR AIR CONDITIONS

Equipment Control Points

Outdoor air temperature – AI
Outdoor air humidity – AI

The sensors shall be mounted in an area on the north side of the building where the representative temperature and humidity can be monitored, both shall have sun shields. Based on the outside air temperature and humidity the BAS shall calculate the outdoor enthalpy, wet bulb, and dew point temperatures. The outdoor air temperature and humidity shall be broadcast as global information for use by the other control programs.

9. COOL-DOWN CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air dampers shall remain closed and the exhaust fans shall be OFF. The duration of the cool-down cycle shall be regulated by the BAS optimum start/stop routine. The cool-down cycle shall continue until all space temperatures are at or below the setpoint. Cool-down cycle shall not be initiated when outside air temperature is less than 80°F.

10. WARM-UP CONTROL

ON-OFF: Prior to the start of the occupied mode, all air handling units shall be started and be controlled as specified except that the outside air dampers shall remain closed and the exhaust fans shall be OFF. The duration of the warm-up cycle shall be regulated by the BAS optimum start/stop routine. The warm-up cycle shall continue until all space temperatures are at or above the setpoint. Warm-up cycle shall not be initiated when outside air temperature is greater than 70°F.

11. HVAC TIMED LOCAL OVERRIDE (TLO)

Equipment Control Points

TLO momentary input – DI

A momentary push button switch shall be located in the principal's office and shall activate the HVAC system (user defined equipment). Each time the momentary button is pushed the assigned equipment will be energized for one hour (adjustable), up to a maximum of four hours (adjustable). If the switch is pushed continuously for seven seconds (adjustable), the override will be cancelled.

12. POWER MONITORING

Equipment Control Points

KW input – Current switch - DI

The BAS shall monitor the building power usage. The BAS control module shall integrate the input and calculate the buildings kWh usage. System graphic shall display the current usage, monthly usage, year-to-date usage, and time and date of the highest peak demand for the month and year. Demand thresholds may be set to adjust setpoints and shed loads in order to reduce peak consumption. All power usage data shall be available in an electronic format that is easily transferrable to the district's energy reporting software.

13. INTERIOR / EXTERIOR LIGHTING CONTROL

Equipment Control Points

Lighting contactors enable/disable - DO

Lighting controllers

The BAS contractor shall provide separate outputs for each contactor indicated on the electrical drawings. Each contactor shall be able to be controlled via operator defined schedule independently or in groups defined by the operator. Provide a photocell for monitoring by the BAS. Exterior lighting shall be turned off if the photocell senses light levels above a pre-determined limit.

Contractor shall program to allow the operator to select whether the system utilizes a boundary schedule and sunrise/sunset calculations. If the exterior lights are scheduled to operate, the operator shall have the option to select to enable them for an adjustable time period before or after sunset and disable for and adjustable time period before or after sunrise.

Provide integration to lighting control system. Provide graphics to show system status of lights and occupancy sensors.

Override

Provide a method of manual override in an easily accessible location (i.e., control relay with integral hand-off-auto in control panel).

14. LIGHTING TLO

Equipment Control Points

Override button input – DI

A local override button located as directed by owner shall allow temporary override of the interior lighting. Each press of the button shall override the system for 30 minutes (adjustable), to a maximum of 90 minutes (adjustable).

15. VARIABLE SPEED DRIVES INTERFACE

Equipment Control Points

Start/stop – DO

Alarm – DI

Last fault – AI

Reset – DO

% output – AI

Frequency output – AI

Speed – AI

Current – AI

Power – AI

Drive temperature – AI

KWh – AI

Runtime - AI

The BAS shall interface directly to each variable speed drive and report all information to the central site.

16. ELECTRIC UNIT HEATERS

Electric unit heaters shall be controlled by a factory furnished thermostat. BAS contractor shall install and wire thermostat.

END OF SECTION 23 09 93

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Chilled water piping.
 - 2. Make-up water piping.
 - 3. Condensate-drain piping.
 - 4. Blowdown drain piping.
 - 5. Air-vent piping.
- B. Related Sections include the following:
 - 1. Section 23 21 23 "Hydronic Pumps" for pumps, motors, and accessories for Hydronic piping.

1.3 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.

1.4 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be 150 PSI pressure class unless otherwise noted or required by project conditions.

1.5 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Provide flanges, union, and couplings at locations requiring servicing.
- B. Provide unions, flanges, and couplings downstream of valves and at equipment or apparatus connections.
- C. Provide non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- D. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

1.6 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following:
 - 1. Plastic pipe and fittings with solvent cement.

2. RTRP and RTRF with adhesive.
 3. Pressure-seal fittings.
- C. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops. The Pipe shop drawings shall be superimposed on the architectural backgrounds.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control test reports.
- C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.
- D. Design Data: Indicate pipe sizes. Indicate pipe sizing methods. Indicate calculations used.
- E. Test Reports: Indicate results of refrigerant leak test and acid test.
- F. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

1.8 QUALITY ASSURANCE

- A. All pipe and accessories shall be of United States domestic manufacture.
- B. Installer Qualifications:
 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- F. Perform Work in accordance with ASME B31.5 code for installation of piping systems and ASME Section IX for welding materials and procedures.

- G. Maintain one copy of each document on site.
- H. Design piping systems under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Division 1 - General Requirements.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system Protect.
- D. Contractor shall adequately protect piping from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- E. Do not deliver piping to the project site until progress of construction has reached the stage where piping is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.10 WELDING

- A. Welding Procedures: Conform to latest recommendations of American Welding Society and Code for Pressure Piping, ANSI B31.1, and current edition. Welding and stress relieving procedures shall conform to Appendix, Section VI, and "Standard Qualifications for Welding Procedures, Welders and Welding Operators."
- B. Locations for Welding: Welding shall not be permitted within occupied area of the building. When the building or a portion of the building is in use as a permanent occupancy welding shall be permitted only in areas physically separated from occupied spaces by fire rated or non-combustible walls to deck or on completely gutted and unoccupied floors.
- C. Fire Protection and Smoke Venting: The Contractor shall provide all manpower and equipment required to protect the building structure and site occupants, other Contractors, etc., from hazards and to remove welding fumes from the building conform to the latest requirements of NFPA 51B.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type B).
- B. Wrought-Copper Fittings: ASME B16.22.

1. Housing: Ductile Iron.
2. Gasket: EPDM, Grade EHP
3. Pipe Sizes 2" and larger
4. Tools: Manufacturer's grooving tools.
5. Minimum 300-psig working-pressure rating at 250 deg F.

C. Copper or Bronze Pressure-Seal Fittings:

1. Housing: Copper.
2. O-Rings and Pipe Stops: EPDM.
3. Pipe Sizes 2" and down
4. Tools: Manufacturer's special tools.
5. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F.

D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A53 Electric Resistance Weld (ERW), Type E, Grade B, Schedule 40 black steel with plain ends; application as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 250.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 1. Material Group: 1.1.
 2. End Connections: Butt welding.
 3. Facings: Raised face.
- H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 PLASTIC PIPE AND FITTINGS

- A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedule 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings; ASTM F 439 for Schedule 80 pipe.
- C. PVC Plastic Pipe: ASTM D 1785, Schedule 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- D. PVC Plastic Pipe Fittings: Socket-type pipe fitting; ASTM D 2467 for Schedule 80 pipe.

2.4 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - a. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- H. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX Inc.
 - c. KBi.
- 2. CPVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

B. Plastic-to-Metal Transition Unions:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. IPEX Inc.
 - c. KBi.
 - d. NIBCO INC.
- 2. MSS SP-107, CPVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
- 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 150 psig minimum at 180 deg F.

- c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
- 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 150 psig minimum at 180 deg F.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
- 2. Description:
 - a. Non-conducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or Phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elster Perfection.
 - b. Matco-Norca, Inc.
 - c. Precision Plumbing Products, Inc.
 - d. Victaulic Company.
- 2. Description:
 - a. Standard: IAPMO PS 66
 - b. Electroplated steel nipple. Complying with ASTM F 1545.
 - c. Pressure Rating: 300 psig 225 deg F.

- d. End Connections: Male threaded or grooved.
- e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Chilled water, and condenser water, above ground, NPS 2 and smaller, shall be the following:
 - 1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Chilled water, and condenser water above ground, NPS 2-1/2 and larger, shall be one of the following:
 - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- C. Makeup-water piping installed aboveground shall be the following:
 - 1. ASTM B 88, Type K (ASTM B 88M, Type B) drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- D. Condensate-Drain Piping: ASTM B 88, Type L (ASTM B 88M, Type B) hard drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
- E. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blow-down drain is installed.
- F. Air-Vent Piping:
 - 1. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.

- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Section 23 05 23 "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping."
- U. Install lateral bracing with pipe hangers and supports to prevent swaying.
- V. Identify piping as specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors.
- X. Install mechanical sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for mechanical sleeve seals specified in Section 23 05 29 - "Hangers and Supports for HVAC Piping and Equipment".
- Y. Sleeve pipe passing through partitions, walls, and floors. Refer to Section 23 05 29 – "Hangers and Supports for HVAC Piping and Equipment".
- Z. Provide access doors where valves and fittings are not accessible.

- AA. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- BB. Provide unions or flanges and isolation valves at each connection to a piece of equipment or control valve; accessory which requires removal for maintenance. Screwed unions should be used for two (2) inches IPS and smaller. Locate joints where they can be accessed for repair. Screw or flanged joints shall not be permitted above inaccessible ceilings or in chases.
- CC. All piping shall be installed to eliminate traps and pockets. Where air pockets or water trap cannot be avoided, provide means for drainage with valved hose connections for water trap and air vents for air pockets. Provide drain valves at low points of the system.
- DD. For pipe inside building, install parallel to lines of building, close to columns and walls vertical pipe shall be truly vertical. Spring or forcing piping into place will not be permitted. Install pipe to prevent strain on equipment connections.
- EE. Provide adequate access to all equipment, motorized valves, instruments, controls, and access panels.
- FF. Allow easy draining of water piping, with drain valves at low points.

3.3 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- F. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- H. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- J. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Non-pressure Piping: Join according to ASTM D 2855.
- K. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- L. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.4 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 230519 "Meters and Gages for HVAC Piping."

3.5 FIELD QUALITY CONTROL

- A. Prepare Hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, un-insulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush Hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

- B. Perform the following tests on Hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that Hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 5. After hydrostatic test pressure has been applied for at least one hour, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of Hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. In-line circulators
 - 2. Split-Coupled Vertical In-line pumps.
 - 3. Automatic Condensate Pump Units
- B. Related Sections:
 - 1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment - Mechanical Vibration Control: Product requirements for vibration isolators required with pumps.

1.3 REFERENCES

- A. Underwriters Laboratories Inc.:
 - 1. UL 778 - Motor Operated Water Pumps.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide pumps electrical characteristics in accordance with Division 26 and schedules on Drawings.

1.5 SUBMITTALS

- A. Submit in accordance with Division 1 and Section 23 05 00.
- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Provide parallel pump curves indicating the non-overloaded motor horsepower for single pump operation when applicable. Include NPSH curve with operating point plotted when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.
- D. Shop Drawings: For each pump.
 - 1. Show pump layout and connections.
 - 2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

- E. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Division 1, General Requirements.
- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.7 WARRANTY

- A. Furnish one (1) year manufacturer parts and labor warranty for pumps. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.8 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
 - 1. Furnish one (1) set of mechanical seals for each pump installed.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Pumps shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 IN-LINE CIRCULATORS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Armstrong
 - 2. Bell and Gossett
 - 3. Aurora
- B. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 175 psig maximum working pressure.
- C. Casing: Cast iron, with flanged pump connections.
- D. Impeller: Cast bronze, dynamically balanced and keyed to shaft.
- E. Bearings: Two, oil lubricated bronze sleeves.
- F. Shaft: Stainless steel with copper or bronze sleeve, integral thrust collar.
- G. Seal: Carbon rotating against stationary ceramic seat, 212 degrees Fahrenheit maximum continuous operating temperature.
- H. Drive: Flexible coupling.
- I. Motor: Single speed and rigidly mounted to pump casing.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.2 "SPLIT-COUPLED" VERTICAL IN-LINE PUMPS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Armstrong - 4300
 - 2. Bell and Gossett
 - 3. Aurora
- B. Type: Vertical shaft, single stage, direct connected, radial split casing, for 175 psig maximum working pressure.

- C. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connections with factory installed seal flush line, recessed cast iron drain pan with threaded connection for field piping to drain, flanged suction and discharge.
- D. Impeller: Bronze, fully enclosed, dynamically balanced, and keyed to shaft.
- E. Bearings: Grease or permanently lubricated roller or ball bearings. Bearings shall have 40,000-hour minimum life.
- F. Shaft: 416 stainless steel with stainless steel shaft sleeve.
- G. Mechanical Seals: Stainless steel multi-spring outside balanced type with a Viton secondary seal, carbon rotating face and Silicon Carbide stationary seat. Provide 316 stainless steel gland plate with factory installed flush line with manual vent, 225 degrees Fahrenheit maximum continuous operating temperature.
- H. Drive: Axially split, spacer type rigid coupling constructed of high tensile aluminum bar with OSHA approved coupling guard.
- I. Motor: Single speed and rigidly mounted to pump casing.
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.3 AUTOMATIC CONDENSATE PUMP UNITS

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Beckett Corporation
 - 2. Hartell Pumps
 - 3. Little Giant Pump Co.
 - 4. Mepco, LLC.
- B. Description: Packaged units with corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory or field-installed check valve and a 72-inch minimum, electrical power cord with plug.

2.4 PUMP SUCTION DIFFUSER

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Armstrong
 - 2. Bell and Gossett
 - 3. Aurora

- B. Angle pattern, with flanged outlet and inlet connections; grooved connections shall not be acceptable.
- C. 175-psig pressure rating, ductile-iron body and end cap, pump-inlet fitting.
- D. Removable stainless steel fine mesh startup and 1/8" perforated stainless-steel star shaped permanent strainers.
- E. Stainless-steel straightening guide vanes.
- F. Drain plug, blow-down tapping in bottom, gage tapping on side.
- G. Factory-fabricated adjustable foot support.
- H. Permanent magnet located in flow stream removable for cleaning.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Provide pumps to operate at specified system fluid temperatures and scheduled capacities. Pumps shall operate without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories. Provide no less than the minimum as required by the manufacturer.
- C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping
- D. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment bases.
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct bases to withstand, without damage to equipment, seismic force required by code.

3. Construct concrete bases 4 high and extend base not less than 6 inches in all directions beyond the maximum dimensions of base-mounted pumps unless otherwise indicated or unless required for seismic-anchor support.
 4. Install base mounted pumps on concrete inertia base “RBMK” with spring isolators. Refer to section 23 05 48.
- E. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers of size required to support weight of in-line pumps.
1. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
 2. Comply with requirements for hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- F. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled, split coupled vertical in-line or base mounted pumps; install supports under elbows on pump suction and discharge line sizes four (4) inches and over.
- G. Provide air cock and drain connection on horizontal pump casings.
- H. Provide drains for bases and seals. Route to floor drain.
- I. Lubricate pumps before start-up according to manufacturer’s instructions.

3.3 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to pump, allow space for service and maintenance.
- C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Discharge side of pumps install non-slam check valve, combination shut-off butterfly valve and throttling valve with memory stop, and thermometer.
- F. Suction side of pumps install suction diffuser with type 304 stainless steel strainer, shut-off butterfly valve on suction side of pumps and thermometer.
- G. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping or install single gage with multiple-input selector valve.

3.4 STARTUP SERVICE

- A. Start up service shall be performed by a factory authorized direct service technician. Start up work shall not be performed by installing mechanical contractor.

1. Complete installation and startup checks according to manufacturer's written instructions.
 - a. Check piping connections for tightness.
 - b. Clean strainers on suction piping.
 - c. Perform the following startup checks for each pump before starting:
 1. Verify bearing lubrication.
 2. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
 3. Verify that pump is rotating in the correct direction.
 - d. Prime pump by opening suction valves and closing drains and prepare pump for operation.
 - e. Start motor.
 - f. Open discharge valve slowly.

3.5 DEMONSTRATION

- A. Demonstration shall be performed by a factory authorized direct service technician. Demonstration shall not be performed by installing mechanical contractor.
 1. Train owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.
 2. Provide documentation of owner training in close out submittal.

END OF SECTION 23 21 23

SECTION 23 22 00 - CONDENSATE PIPING

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section Includes: Pipe and pipe fitting materials, joining methods and pipe insulation for the following systems:
 - 1. Condensate equipment drains and overflows.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and fire stopping for placement by this section.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 2. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 3. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 4. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 - 5. ASME B31.1 – Power Piping.
 - 6. ASME B31.5 - Refrigeration Piping.
 - 7. ASME B31.9 - Building Services Piping.
 - 8. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- B. ASTM International (ASTM):
 - 1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 3. ASTM A536 – Standard Specification for Ductile Iron Castings.

4. ASTM B32 - Standard Specification for Solder Metal.
 5. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- C. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS D1.1 - Structural Welding Code - Steel.

1.4 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Provide flanges, union, and couplings at locations requiring servicing.
- B. Provide unions, flanges, and couplings downstream of valves and at equipment or apparatus connections.
- C. Provide non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- D. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

1.5 ACTION SUBMITTALS

- A. Submit in accordance with Division 1 - General Requirements.
- B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes. Indicate schematic layout of refrigeration system, including equipment, critical dimensions, and sizes.
- C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.
- D. Design Data: Indicate pipe sizes. Indicate pipe sizing methods. Indicate calculations used.
- E. Test Reports: Indicate results of refrigerant leak test and acid test.
- F. Welders' Certificate: Include welders' certification of compliance with ASME Section IX.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Field quality-control test reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- E. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years experience.
- F. Installer: Company specializing in performing Work of this section with minimum three (3) years experience approved by manufacturer.
- G. Design piping systems under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.
- H. All pipe and accessories shall be of United States domestic manufacture.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Division 1 - General Requirements.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system Protect.
- D. Contractor shall adequately protect material from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- E. Do not deliver Piping to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WELDING

- A. Welding Procedures: Conform to latest recommendations of American Welding Society and Code for Pressure Piping, ANSI B31.1, and current edition. Welding and stress relieving procedures shall conform to Appendix, Section VI, and "Standard Qualifications for Welding Procedures, Welders and Welding Operators."
- B. Locations for Welding: Welding shall not be permitted within occupied area of the building. When the building or a portion of the building is in use as a permanent occupancy welding shall be permitted only in areas physically separated from occupied spaces by fire rated or non-combustible walls to deck or on completely gutted and unoccupied floors.
- C. Fire Protection and Smoke Venting: The Contractor shall provide all manpower and equipment required to protect the building structure and site occupants, other Contractors, etc., from hazards and to remove welding fumes from the building conform to the latest requirements of NFPA 51B.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).
- B. Wrought-Copper Fittings: ASME B16.22.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - A. Anvil International, Inc.
 - B. S. P. Fittings; a division of Star Pipe Products.
 - C. Victaulic Company.
- C. Copper or Bronze Pressure-Seal Fittings:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - A. Stadler-Viega.
 - 2. Housing: Copper.
 - 3. O-Rings and Pipe Stops: EPDM.
 - 4. Tools: Manufacturer's special tools.
 - 5. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F (121 deg C).

- D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Seamless galvanized steel with plain ends; schedule 40, 0.375-inch wall.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150.
- E. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

2.3 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BA9-1, silver alloy for joining copper with bronze or steel.
- C. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - A. Capitol Manufacturing Company.
 - B. Hart Industries International, Inc.
 - C. Jomar International Ltd.
 - D. Matco-Norca, Inc.
 - E. McDonald, A. Y. Mfg. Co.
 - F. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - G. Wilkins; a Zurn company.
 - 2. Description:
 - A. Standard: ASSE 1079.
 - B. Pressure Rating: 125 psig minimum at 180 deg F.
 - C. End Connections: Solder-joint copper alloy and threaded ferrous.

2.5 PIPING INSULATION

- A. High density factory molded fiberglass insulation with factory applied all service, and reinforced vapor retarder jacket. Provide with a factory applied pressure sensitive tape closure system and matching butt strips. 1" thick for all pipe sizes and locations.
 - 1. Thermal conductivity "k" of 0.23 of Btu-in / hr-sq.ft. Degree F at 75-degree mean temperature.
 - 2. Maximum jacket permeance shall be 0.02.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - A. Johns Manville.
 - B. Owens Corning
 - C. Knauf.
 - D. CertainTeed

- C. Aluminum Jacket: General Requirements: Provide aluminum jacketing for all condensate drain piping located outdoors.
 - A. Jacket for piping shall be 0.016-inch-thick type 3105 aluminum with factory applied one mil polykraft moisture barrier.
 - B. Fitting covers shall be factory made 0.024-inch type 1100 aluminum to match pipe covering.

PART 3 - EXECUTION

3.1 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- F. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- H. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.2 PIPING INSTALLATION

- A. Route piping parallel to building structure and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space.
- C. Sleeve pipe passing through partitions, walls, and floors. Refer to Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- D. Install piping free of sags and bends.
- E. Install piping to allow application of insulation.

3.3 INSULATION INSTALLATION

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.
- D. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
- E. Install insulation on piping subsequent to installation of heat tracing, painting, and acceptance tests.
- F. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.
- G. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tears, or other damage. All staples used on cold pipe insulation shall be coated with suitable sealant to maintain vapor barrier integrity.
- H. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

- I. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- J. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- K. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- L. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- M. Keep insulation materials dry during application and finishing.
- N. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- O. Apply insulation with the least number of joints practical.
- P. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
- Q. Apply insulation continuously through hangers and around anchor attachments.
- R. For insulation application where vapor retarder are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- S. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
- T. Insulation Terminations: For insulation application where vapor retarder is indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

END OF SECTION 23 22 00

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Refrigerant piping.
2. Unions, flanges, and couplings.
3. Refrigerant moisture and liquid indicators.
4. Valves.
5. Refrigerant strainers.
6. Refrigerant pressure regulators.
7. Refrigerant pressure relief valves.
8. Refrigerant filter-driers.
9. Refrigerant solenoid valves.
10. Refrigerant expansion valves.
11. Electronic expansion valves.
12. Refrigerant receivers.

- B. Related Sections:

1. Section 07 84 00 - Firestopping: and Fire Safing Product requirements for firestopping for placement by this section.
2. Section 08 31 13 - Access Doors: Access doors for concealed valves and accessories.
3. Section 09 91 00 - Painting and Staining: Product requirements for painting for placement by this section.
4. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and sleeves for placement by this section.
5. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for Vibration Isolation for placement by this section.

6. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for pipe identification for placement by this section.
7. Section 23 07 19 - HVAC Piping Insulation: Product requirements for Piping Insulation for placement by this section.
8. Section 23 21 13 - Hydronic Piping: Piping materials for refrigerant systems.

1.3 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 1. ARI 495 - Refrigerant Liquid Receivers.
 2. ARI 710 - Liquid-Line Driers.
 3. ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Dryers.
 4. ARI 750 - Thermostatic Refrigerant Expansion Valves.
 5. ARI 760 - Solenoid Valves for Use with Volatile Refrigerants.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- C. American Society of Mechanical Engineers:
 1. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 3. ASME B31.5 - Refrigeration Piping.
 4. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
- D. ASTM International (ASTM):
 1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 2. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 3. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

5. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
- E. American Welding Society:
 1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS D1.1 - Structural Welding Code - Steel.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- G. Underwriters Laboratories Inc.:
 1. UL 429 - Electrically Operated Valves.

1.4 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-407C:
 1. Suction Lines for Air-Conditioning Applications: 230 psig.
 2. Suction Lines for Heat-Pump Applications: 380 psig.
 3. Hot-Gas and Liquid Lines: 380 psig.
- B. Line Test Pressure for Refrigerant R-410A:
 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 2. Suction Lines for Heat-Pump Applications: 535 psig.
 3. Hot-Gas and Liquid Lines: 535 psig.

1.5 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.
- C. Provide pipe hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- D. Provide receivers sized to accommodate pump down charge.
- E. Flexible Connectors: Use at or near compressors where piping configuration does not absorb vibration.

1.6 SUBMITTALS

- A. Submit in Accordance with Division 1 - General Requirements.
- B. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cut sheets to fulfill submittal requirements. Select and show specific pertinent performance data and quantities appropriate to scope of work.
- C. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.
- D. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 - 4. Refrigerant Specialties: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes for the following:
 - a. Refrigerant moisture and liquid indicators.
 - b. Refrigerant strainers.
 - c. Refrigerant pressure regulators.
 - d. Refrigerant pressure relief valves.
 - e. Refrigerant filter-driers.
 - f. Refrigerant solenoid valves.
 - g. Refrigerant expansion valves.
 - h. Electronic expansion valves.
- E. Test Reports: Indicate results of piping system pressure test.
- F. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.
- G. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- H. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves, equipment and refrigerant accessories.
- B. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.8 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years experience.
- B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three (3) years experience approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Division 1- General Requirements.
- B. Dehydrate and charge refrigeration components including piping and receivers, seal prior to shipment. Maintain seal until connected into system.
- C. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- F. Contractor shall adequately protect material from damage after delivery to the project. Piping shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- G. Do not deliver Piping to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

1.11 WARRANTY

- A. Furnish five (5) year manufacturer warranty for valves excluding packing.

1.12 MAINTENANCE MATERIALS

- A. Furnish two (2) refrigerant oil test kits each containing everything required for conducting one test.

1.13 EXTRA MATERIALS

- A. Furnish two (2) packing kits for each size and valve type.
- B. Furnish two (2) refrigerant filter-dryer cartridges of each type.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPING

- A. Copper Tubing: ASTM B 280, Nitrogenized Type L - ACR hard drawn.
 - 1. Wrought-copper Fittings: ASME B16.22.
 - 2. Brazing Filler Metals: AWS A5.8. BCuP: minimum 15% silver (Ag), 5% phosphorous (P), and balance copper (Cu).
 - 3. Final product composition shall be 99% pure copper and lead free.
 - 4. Provide in 10 ft. and 20 ft. straight tube lengths.
 - 5. **Bendable pipe of any kind shall not be accepted.**

2.2 UNIONS, FLANGES, AND COUPLINGS

- A. Two (2) inches and Smaller:
 - 1. Copper Pipe: Bronze, soldered joints.
- B. 2-1/2 inches and Larger:
 - 1. Copper Piping: Bronze
 - 2. Gaskets: 1/16-inch-thick preformed neoprene.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.3 REFRIGERANT MOISTURE AND LIQUID INDICATORS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Alco Controls Div, Emerson Electric Co.

2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
3. Sporlan Valve Co.

B. Indicators:

1. Port: Single, UL listed.
2. Body: Brass, solder ends.
3. Sight glass: Color-coded paper moisture indicator with removable element cartridge and plastic cap.
4. Maximum working pressure: 500 psig
5. Maximum working temperature: 200 degrees Fahrenheit.

2.4 VALVES

A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.

1. Alco Controls Div, Emerson Electric Co.
2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
3. Sporlan Valve Co.

B. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet solder or flared ends.
2. Phosphor bronze and stainless-steel diaphragms, rising stem and hand wheel.
3. Stainless steel spring, nylon seats, disc with positive back seating.
4. Maximum working pressure: 500 psig
5. Maximum working temperature: 275 degrees Fahrenheit.

C. Packed Angle Valves:

1. Forged brass, solder ends.
2. Forged brass seal caps with copper gasket, rising stem and seat with back seating, molded stem packing.
3. Maximum working pressure: 500 psig
4. Maximum working temperature: 275 degrees Fahrenheit.

D. Ball Valves:

1. Two piece bolted forged brass body with Teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals, soldered ends.
 2. Maximum working pressure: 500 psig and
 3. Maximum working temperature: 300 degrees Fahrenheit.
- E. Service Valves:
1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, solder ends.
 2. Maximum working pressure: 500 psig.
- F. Refrigerant Check Valves:
1. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - a. Alco Controls Div, Emerson Electric Co.
 - b. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 - c. Sporlan Valve Co.
 2. Globe Type:
 - a. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless-steel spring, Teflon seat disc.
 - b. Maximum working pressure: 500 psig.
 - c. Maximum working temperature: 300 degrees Fahrenheit.
 3. Straight Through Type:
 - a. Spring, neoprene seat.
 - b. Maximum working pressure: 500 psig.
 - c. Maximum working temperature: 250 degrees Fahrenheit.

2.5 REFRIGERANT STRAINERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Alco Controls Div, Emerson Electric Co.
 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 3. Sporlan Valve Co. Model.

- B. Straight Line or Angle Line Type:
 - 1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless-steel wire or monel reinforced with brass.
 - 2. Maximum working pressure: 430 psig.

2.6 REFRIGERANT PRESSURE REGULATORS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 - 3. Sporlan Valve Co.
- B. Brass body, stainless steel diaphragm, pilot operated with remote pressure pilot, adjustable over 0 to 80 psig range, for maximum working pressure of 450 psig.

2.7 REFRIGERANT PRESSURE RELIEF VALVES

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division.
 - 3. Sporlan Valve Co.
- B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; setting selected to ASHRAE 15.

2.8 REFRIGERANT FILTER-DRIERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Alco Controls Div, Emerson Electric Co.
 - 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 - 3. Sporlan Valve Co.
- B. Replaceable Cartridge Angle Type:
 - 1. Shell: ARI 710, UL listed, steel, removable cap, for maximum working pressure of 500 psig, and wrought copper fittings for solder end connections.
 - 2. Filter Cartridge: Pleated media with integral end rings, stainless steel support.

3. Filter/Dryer Cartridge: Pleated media with solid core sieve with activated alumin to provide micron filtration.
 4. Wax Removal Cartridge: Molded bonded core of activated charcoal with integral gaskets.
- C. Permanent Straight Through Type:
1. ARI 710, UL listed, steel shell with molded desiccant filter core, for maximum working pressure of 500 psig.
 2. Permanent filter element shall be molded felt core surrounded by a desiccant for removal of acids and moisture for refrigerant vapor.

2.9 REFRIGERANT SOLENOID VALVES

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Alco Controls Div, Emerson Electric Co.
 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 3. Sporlan Valve Co.
- B. Valve: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly, integral strainer, solder ends; for maximum working pressure of 500 psig. Stem designed to allow manual operation in case of coil failure.
- C. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color-coded lead wires, integral junction box.

2.10 REFRIGERANT EXPANSION VALVES

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Alco Controls Div, Emerson Electric Co.
 2. Parker Hannifin Corp., Refrigeration & Air Conditioning Division
 3. Sporlan Valve Co.
- B. Angle or Straight Through Type: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with replaceable capillary tube and remote sensing bulb and remote bulb well.
- C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum ten (10) degrees Fahrenheit superheat. Select to avoid being undersized at full load and oversized at part load.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION

- A. Route piping parallel to building structure and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space.
- C. Group piping whenever practical at common elevations.
- D. Sleeve pipe passing through partitions, walls, and floors. Refer to Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- E. Install pipe identification in accordance with Section 23 05 53 - Identification for HVAC Piping and Equipment.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Arrange refrigeration piping to return oil to compressor. Provide traps and loops in piping, and where necessary provide double risers. Slope horizontal piping 0.40 percent in direction of flow.
- H. Provide access where valves and fittings are not exposed.
- I. Flood refrigerant piping system with nitrogen when brazing.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- K. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 91 00.
- L. Install valves with stems upright or horizontal, not inverted.
- M. Provide replaceable cartridge filter-dryers, with isolation valves and bypass with valve.
- N. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- O. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

- P. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- Q. Provide electrical connection to solenoid valves.
- R. Fully charge completed system with refrigerant after testing.
- S. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
- T. Install refrigerant piping in accordance with ASME B31.5.
- U. Install piping in as short and direct arrangement as possible to minimize pressure drop.
- V. Install piping with minimum number of joints using as few elbows and other fittings as possible.
- W. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.
- X. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.
- Y. Insulate suction lines. Liquid lines are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.
 - 1. Do not install insulation until system testing has been completed and all leaks have been eliminated.
 - 2. Insulation shall be AP Armaflex pipe insulation. Provide 1-inch insulation thickness. All seams and joints shall be adhered and sealed using Armaflex 520 adhesive. All fittings shall be insulated with same insulation thickness as straight pipe.
 - 3. **Exposed refrigerant liquid and suction piping (located indoors and/or outdoors)**: shall be insulated and include two (2) coats of WB Armaflex Finish. In addition, liquid and suction lines shall be provided with aluminum jacketing; provide 0.016-inch Type 3105 on all exterior insulated piping. Fitting covers shall be 0.024-inch Type 1100 aluminum. Jacketing and fitting covers shall be banded with 0.20-inch Type 3105, 1/2-inch-wide banding with 0.32-inch Type 5005 wing seals on 12-inch centers.
- Z. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.
- AA. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- BB. Slope refrigerant piping as follows:

1. Install horizontal hot gas discharge piping with 1/2 inch per ten (10) feet downward slope away from the compressor.
 2. Install horizontal suction lines with 1/2 inch per ten (10) feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
 3. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.
 4. Liquid runs
- CC. Use fittings for all changes in direction and all branch connections.
- DD. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- EE. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- FF. Conceal all pipe installation in walls, pipe chases, utility spaces, above ceilings, below grade floors, unless indicated to be exposed to view.
- GG. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with one (1) inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- HH. Locate groups of pipe parallel to each other, spaced to permit applying insulation and servicing or valves.
- II. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than six (6) inches shall be steel; pipe sleeves six (6) inches and larger shall be sheet metal.
- JJ. Fire Barrier Penetrations: Seal pipe penetrations through fire rated wall, partitions, ceilings, and floors, maintain the fire rated integrity.
- KK. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.
- LL. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.
- MM. Install moisture / liquid indicators in liquid lines between filter / driers and thermostatic expansion valves and in liquid line to receiver.
1. Install moisture / liquid indicators in lines larger than 2-1/8-inch OD, using a bypass line.
- NN. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators.

OO. Install flexible connectors at the inlet and discharge connection of compressors.

3.3 INSTALLATION - REFRIGERANT SPECIALTIES

A. Refrigerant Liquid Indicators:

1. Install line size liquid indicators in main liquid line downstream of condenser.
2. When receiver is provided, install line size liquid indicators in liquid line downstream of receiver.
3. Install line size liquid indicators downstream of liquid solenoid valves.
4. Install liquid indicator on leaving side of filter-driers.

B. Refrigerant Valves:

1. Install service valves on compressor suction and discharge.
2. Install gage taps at compressor inlet and outlet.
3. Install gage taps at hot gas bypass regulators, inlet, and outlet.
4. Install check valves on compressor discharge.
5. Install check valves on condenser liquid lines on multiple condenser systems.
6. Install refrigerant charging valve in liquid line between receiver shut-off valve and expansion valve.

C. Strainers:

1. Install line size strainer upstream of each automatic valve.
2. Where multiple expansion valves with integral strainers are used, install single main liquid-line strainer.
3. On steel piping systems, install strainer in suction line.
4. Install shut-off valves on each side of strainer.

D. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.

E. Filter-Dryers:

1. Install permanent filter-dryers in low temperature systems.
2. Install permanent filter-dryer in systems containing hermetic compressors.
3. Install replaceable cartridge filter-dryer vertically in liquid line adjacent to receivers.
4. Install replaceable cartridge filter-dryer upstream of each solenoid valve.

F. Solenoid Valves:

1. Install in liquid line of systems operating with single pump-out or pump-down compressor control.
2. Install in liquid line of single or multiple evaporator systems.
3. Install in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

3.4 PIPE JOINT CONSTRUCTION

- A. Brazed Joints: Comply with the procedures contained in the AWS: Brazing Manual".
 1. **WARNING:** Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
 2. **CAUTION:** When solenoid valves are being installed, remove the coil to prevent damage. When sight glasses are being installed, remove the glass. Remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties before brazing. Do not apply heat near the bulb of the expansion valve.
- B. Pressurize the pipe and fittings during brazing with nitrogen to prevent formation of harmful oxides.
- C. Heat joints using-acetylene torch. Heat to proper and uniform brazing temperature.

3.5 VALVE INSTALLTIONS - GENERAL

- A. General: Install refrigerant valves in accordance with manufacturer's instructions.
- B. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere as indicated.
- C. Install a full sized, 3-valve bypass around each drier.
- D. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at the top.
 1. Coordinate electrical requirements and connections.
- E. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.
 1. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.
 2. Install the valve in such a location so that the diaphragm case is warmer than the bulb.
 3. Secure the bulb straps. Do not mount build in a trap or at the bottom of the line.
 4. Where external equalizer lines are required make the connection where it clearly reflect the pressure existing in the suction line at the bulb location.

- F. Install pressure regulating and relieving valves required by ASHRAE Standard 15.

3.6 EQUIPMENT CONNECTIONS

- A. Install piping adjacent to machine to allow servicing and maintenance.

3.7 FIELD QUALITY CONTROL

- A. Install, test, and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI.
- B. Repair leaking joints using new materials and retest for leaks.

3.8 CLEANING

- A. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedures:
 1. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.
 2. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 3. Draw a clean, lintless cloth saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint.
 4. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.9 ADJUSTING AND CLEANING

- A. Verify actual evaporator applications and operating conditions and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.
- B. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

3.10 SYSTEM CHARGING

- A. Charge system using the following procedure:
 1. Install core in filter dryer after leak test but before evacuation.
 2. Evacuate entire refrigerant system with a vacuum pump to 500 microns. When vacuum holds for a minimum of 24 hours, system is ready for charging.
 3. During excavation, apply heat to pockets, elbows, and low spots in piping.
 4. Break vacuum with refrigerant gas, allow pressure to build up to 2 psig.
 5. Charge system with a new filter-dryer core in charging line.

- B. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, trouble shooting, servicing, and preventive maintenance of refrigerant piping valves and refrigerant piping specialties.
- C. Review data in Operating and Maintenance Manuals.
- D. Schedule training with Owner with at least seven (7) days advance notice.

END OF SECTION 23 23 00

SECTION 23 25 13 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

- B. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.
- C. The Common Work Results for HVAC, Section 23 05 00, are included as a part of this Section as though written in full in this document.

1.3 SCOPE

- A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

1.4 DESCRIPTION OF WORK

- A. Work Included: Perform water analysis and provide all water treatment products, holding reservoirs, equipment and labor for testing, cleaning, flushing and dispensing products to control water quality for each system specified hereinafter as follows:
 - 1. Chilled Water Systems
- B. Chemicals: Provide, at no additional cost to the Owner, all chemicals required for operating and testing all water treatment systems prior to and for three months after acceptance by the Owner.
- C. Instructions: Provide operating and maintenance instructions for each water treatment system; include one set in each Owner's Manual and deliver one set to Owner's operating personnel.
- D. Testing Equipment and Reagents: Furnish suitable water treatment equipment for each system, complete with apparatus and reagents necessary for operation prior to and for three months after acceptance by the Owner.
- E. Service Representative: Furnish the services of a qualified service representative to instruct Owner's operating personnel in proper operation and maintenance of water treatment equipment, systems and tests required. Service representative shall return to the site bi-weekly during first 2 months of operation and monthly during the remainder of the guarantee period. At such time, service representative shall check and adjust water treatment system operation, check efficiency of chemicals and chemical applications, and instruct and advise operating personnel.
- F. Replacement and Rework: Replace defective or nonconforming materials and equipment with new materials and equipment at no additional cost to the Owner for 1 year after successful start-up of the system. All warranty work shall be FOB as installed at the project site.

1. Guarantee: Provide system produced by manufacturer who is willing to execute the required guarantee.
2. Agreement to Maintain: Provide system produced by manufacturer who is willing to execute (with the Owner) the required agreement for continued maintenance of the system.

1.5 QUALITY ASSURANCE

- A. Qualifications: The Contractor for work under this Section shall have:
 1. Research and development facilities.
 2. Regional laboratories capable of making water analysis.
 3. A service department and qualified technical service representative located within a reasonable distance of the project site.
 4. Service representatives who are Registered Engineers of factory-certified technicians with not less than 5 years of water treatment experience with the water treatment system manufacturer.
- B. Packaging and Labeling: Supply water treatment chemicals in metal drums, fiber drums with plastic liners, or plastic lined "liqui-paks" as best suited to the materials. Paper bags or unlined cardboard cartons will not be acceptable. Use only chemicals in domestic water systems, all coincides regardless of where used, which are registered with the U.S. Department of Agriculture (USDA) or the U.S. Environmental Protection Agency (EPA) and which are labeled as required by law.
- C. Electrical Standards: Provide electrical products which have been tested, listed and labeled by Underwriters Laboratories (UL) and which comply with National Electrical Manufacturers' Association (NEMA) standards.
- D. Chemical Standards: Provide chemical products acceptable under state and local pollution control or other governing regulations.

1.6 SUBMITTALS

- A. Test reports: Submit test reports certified by an officer of the firm, on water treatment company letterheads, of samples of each treated water system specified. Comply with ASTM D 596 for reporting. Indicate the ASTM best methods for each test.
- B. Shop Drawings: Submit shop drawings for each water treatment system. Show wiring, piping and tubing sizes, fittings, accessories, valves and connections.
- C. Guarantee: Submit written guarantee signed by the Manufacturer and countersigned by the Installer and Contractor, agreeing to adjust or replace the chemicals in the systems as required achieving the required performance, during a 1-year period following the final start-up or the continued operation of the chillers.
- D. Agreement to Maintain: Prior to the time of final acceptance, the Manufacturer of the chilled water treating system shall submit four copies of an "Agreement for Continued Service and the Owner's possible acceptance." Offer terms and conditions for furnishings chemicals and providing continued testing and equipment for a 1-year period with option for renewal of the Agreement by Owner.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Nalco
 2. Garratt-Callahan

2.2 GENERAL

- A. Water Analysis: Determine which chemicals to use from the results of a water sample analysis taken from the building site by the system manufacturer. Provide ingredients necessary to achieve the desired water conditions.
- B. Pre-Treatment: For new construction and/or renovations to existing Hydronic systems treat chilled water piping systems with chemicals to remove and permit flushing of mill scale, oil, grease, and other foreign matter. Chemicals shall be equal to Nalco 2578 prepping compound. A school district supervisor is to be present to observe cleaning of chilled water piping systems. **SYSTEMS SHALL NOT BE STARTED UP UNTIL THE PIPING HAS BEEN CLEANED.**

CLEANING OF CHILLED WATER PIPING SYSTEMS:

1. General cleaning of piping systems. Purge pipe of construction debris and contamination before placing the system in service. Provide and install temporary connections as required to clean, purge, and circulate. Flush the chilled water systems utilizing the filter feeders.
2. Install temporary strainers at the inlet of pumps and other equipment as necessary where permanent strainers are not indicated. Keep strainers in service until the equipment has been tested, then remove either entire strainer or straining element only. Fit strainers with a line size blow down ball valve and pipe to nearest drain. Blow down strainers, remove and clean as frequently as necessary.
3. Phase One: initial flushing of system. Remove loose dirt, mill scale, weld heads, rust, and other deleterious substances without damage to system components. Open valves, drains, vents, and strainers at all system levels during flushing procedures. Flush until "potable water clear" and particles larger than 5 microns are removed.
4. Connect dead-end supply and return headers, even if not shown on the drawings, and provide terminal drains in bottom of pipe end caps or blind flanges.
5. Dispose of water in approved manner.
6. Phase Two: Cleaning of piping system. Remove, without chemical or mechanical damage to any system component, adherent dirt (organic soil), oil, grease, (hydrocarbons), welding and soldering flux, and Mill varnish, piping components, rust (iron oxide) and other deleterious substances not removed by initial flushing. Chemical shall be approved equivalent to Nalco 2578 prepping compound. Insert anti-foam compound, as necessary. Circulate for 48 hours or as recommended by the manufacturer. Dispose of water in an approved manner. Flush system and

replace with clean water. Verify compatibility of chemicals used with existing chemical treatment program on remodel projects. For aluminum heat exchangers within condensing boiler, maintain pH less than 8.5, per manufacturer's recommendations.

7. Phase Three: Final flushing and rinsing until "potable water clear" and particles larger than 5 microns are removed. Operate valves to dislodge any debris in valve body. Dispose of water in approved manner.
 8. Submit status report upon completion of each phase of work on each system.
 9. Special requirements, if any, are specified in the sections on each type of piping.
- C. FDA and USDA Approval: use only FDA and USDA-approved products in system with direct connection to domestic water systems.
- D. Governing Laws: Ensure that neither products, waste, blow-down nor other effluents violate local, state, EPA, or other agency regulations in effect in the project area.

2.3 CHILLED WATER SYSTEMS

- A. Chemicals: Provide water treatment products which contain inhibitors that perform the following:
1. Form a protective film to prevent corrosion and scale formation to maintain iron levels between 0.0 and 0.5 as Fe.
 2. Scavenge oxygen and protect against scale.
 3. Remain stable throughout operating temperature range.
 4. Are compatible with pump seals and other elements in the system.
 5. For aluminum condensing boilers, molybdate at 10 to 25 ppm and maintain pH limit below 8.5; refer to boiler manufacturer's recommendation.
 6. Chilled Water Loop: The inhibitor shall be a boron-nitrate scale inhibitor compound at 650 to 750 ppm as NO₂ (Nitrite); pH of 9.5 to 10.5; and to maintain Fe (Iron) levels between 0.0 and 0.5 ppm.
- B. Equipment: Provide a bypass feeder with a 5-gallon capacity. The feeder shall be constructed of 10-gauge steel and impervious to the products dispensed. Tank heads shall be a minimum of 9-gauge steel and shall be rated at 300 psi and to 200°F. Chemical feeder shall have inlet and outlet drain valves with full bottom drain. The tank shall have a wide mouth, 3-1/2" opening so that chemical addition can be performed without the need of a funnel. The bypass feeder shall have a continuous threaded closure requiring 2-1/2 turns to close and seal. Closures rated less than 300 psi shall not be considered equal.

The cap shall be constructed of cast iron with an epoxy-coated underside to prevent corrosion and shall use a square ring gasket seal. The ring gasket shall not be glued or restrained from movement. Closures using "o" rings or gaskets which are glued or restrained from free movement by snap rings shall not be considered equal.

Provide bypass feeder with legs to elevate the feeder off of the floor. The legs shall have holes to allow mounting to anchor bolts.

The bypass feeder shall be provided with a 5-micron filter bag fully supported by a stainless-steel filter basket for simultaneous side stream filtering.

1. Acceptable Manufacturer: Neptune, model FTF-5DB.
- C. Test Kit: Provide test kit and reagents for determining proper water conditions.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS PREPARATION:

- A. General: After piping systems are erected and proven free of leaks, administer chemicals required for preparation treatment and flushing. Apply chemicals for the time period and in the concentration recommended by the water treatment manufacturer for this portion of the work.
- B. Testing: Perform test procedures and submit a written report of test conditions and results to the Engineer. If test results are unsatisfactory, repeat preparation treatment as necessary to achieve test results approved by the Owner's insurance carrier and the Engineer.

3.2 FLUSHING:

- A. Drain preparation and boil out products from the systems. Flush with clean water until system tests prove systems are free of preparation and boil out products and other contaminants prior to administering system water treatment as specified hereinbefore.

3.3 CHILLED WATER SYSTEM:

- A. Treatment: Treat initial water charge to chilled water loop at 650-750 ppm as NO₂ water systems, after system has been flushed and prepped, to achieve a water quality as specified.
- B. Start-up Procedures: During chilled water system start-up, operate chilled water treating systems (after charging with specified chemicals) to maintain the required steady-state characteristics of cooling water. Demonstrate system operation to Owner's operating personnel.
- C. Reports: Prepare certified test report for each required water performance characteristic. Comply with the following ASTM standard, where applicable:
 1. D 859 - Tests for Silica in Water and Water Waste
 2. D 1067 - Tests for Acidity or Alkalinity of Water
 3. D 1068 - Tests for Iron in Water and Wastewater
 4. D 1126 - Tests for Hardness in Water
 5. D 1128 - Tests for Identification of Types of Microorganisms and Microscopic Matter in Water and Wastewater

6. D 3370 - Sampling Water

- D. Water Chemistry: Where water chemistry substantiates that pH is not necessary, chemical fee shall be based on water makeup qualities. Water analysis shall be based on the full parameters of operation, and all possible water supplies. Total hardness and "M" alkalinity of the makeup water will be the determining factor along with the technical limitations of the inhibitors.

3.4 PERSONNEL TRAINING:

- A. Operator Training: Train Owner's personnel in use and operation of chilled water treating systems including preparation of chemical solution reservoir. A Program Administration Manual shall be furnished encompassing all systems in this section of the Specifications.

END OF SECTION 23 25 13

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and Flat Oval ducts and fittings.
3. Double-wall rectangular ducts and fittings.
4. Double-wall round and Flat Oval ducts and fittings.
5. Insulated Flexible Ducts
6. Sheet metal materials.
7. Sealants and gaskets.
8. Hangers and supports.

- B. Related Sections:

1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
3. Section 23 07 13 Section "Duct Insulation" for internal duct liner.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following products:
 1. Adhesives.

2. Sealants and gaskets.

C. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. $\frac{1}{4}'' = 1'-0''$ Scale Duct layout drawings indicating sizes, configuration, liner material, static-pressure classes, and bottom of duct elevations. Duct shop drawings shall be superimposed on the architectural backgrounds with the reflected ceiling plans.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

D. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.

5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports, and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Open ends of ductwork shall be factory shrink wrapped air and watertight before shipment to jobsite.

B. Contractor shall adequately protect ductwork from damage after delivery to the project. Ductwork shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

C. Do not deliver ductwork to the project site until progress of construction has reached the stage where ductwork is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Fabricate ducts with indicated dimensions for the inner duct.
- B. Sheet Metal Connectors, Inc
- C. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS

- A. Fabricate ducts with indicated dimensions for the inner duct.
- B. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- C. Triple-Rib shall be acceptable for single wall spiral lockseam ducts: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- F. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg. F mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg. F mean temperature.

- G. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Fabricate ducts with indicated dimensions for the inner duct.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
 - 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Transverse Joints in Ducts Larger Than 60 Inches Diameter: Flanged.
 - 2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
 - 3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: $K = 0.23$ at 75 deg F mean temperature.

2.5 DOUBLE-WALL FLAT OVAL / ROUND / RECTANGULAR OUTDOOR DUCTWORK

- A. Fabricate ducts with indicated dimensions for the inner duct.
- B. Material:
 - a. Stainless steel type 304L conforming to ASTM standard A240.
 - b. Material thickness constructed in accordance with latest SMACNA's HVAC Duct Construction Standards.
- C. Inner Duct: Minimum 0.125-inch perforations on 0.250" staggered centers, with an overall open area of 23%.
- D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B.
 - 1. Minimum 2" insulation and R-value of 8 at 75°F mean ambient temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
- E. Exterior Coating / Finish.
 - 1. Epoxy coated exterior duct.
 - 2. Average thickness of 4 mils to meet or exceed 3,000-hour salt spray test per ASTM B17-97.
 - 3. Coordinate color with the architect and the owner.

2.6 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - c. Thermaflex Type M-KE.
 - d. Atco
- B. Product Description: UL 181, Class 1, CPE fabric attached to helical wound spring galvanized steel wire; fiberglass insulation; aluminized vapor barrier film.
 - a. Pressure Rating: six (6) inches wg positive and four (4) inches wg negative.
 - b. Maximum Velocity: 4,000 fpm.
 - c. Temperature Range: -20 degrees Fahrenheit to 210 degrees Fahrenheit.
 - d. Thermal Resistance: Minimum R-6 installed.
 - e. Maximum flexible duct length shall not exceed 5'-0".
- C. Provide Flexible Duct Elbow Supports at each diffuser. Refer to "23 33 00 Air Duct Accessories"; 2.10 Flexible Duct Elbow Supports.

2.7 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 (Z180).
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches.

2.8 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

- B. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 8. Service: Indoor or outdoor.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

- C. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

- E. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

- D. Duct straps shall be wrapped from the top cord of joists; straps wrapped from the bottom chord will not be accepted.

- E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

- F. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

- G. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- H. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- I. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Ductwork installed on the roof shall be installed and supported such that the roof may be maintained / repaired without the need to disassemble any ductwork.

3.2 REQUIREMENTS FOR DRYER EXHAUST DUCTS

- A. Dryer exhaust ducts for clothes dryers shall be smooth, rigid galvanized duct and shall terminate on the outside of the building and shall be equipped with a backdraft damper. Ducts shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the exhaust flow. Clothes dryer exhaust ducts shall not be connected to a vent connector, vent, or chimney. Clothes dryer exhaust ducts shall not extend into or through ducts or plenums. Provide weather resistant stainless-steel wall cap at duct / wall penetration and a minimum 8" relief hood at roof penetration with roof curb, flashing and counter flashing.

3.3 REQUIREMENTS OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 ADDITIONAL REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.5 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. For fastening of sheet metal support straps on each side of the duct, provide (2) two sheet metal screws on the side of the duct and (1) one on the bottom of the duct for a total of (6) six sheet metal screws for maximum fastening of strap to sheet metal duct.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.7 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

- A. Paint all outdoor ductwork, exposed ductwork and exterior of metal ducts that are visible through cloud ceilings, registers, and grilles, etc. and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer; refer to paint manufacturer's instructions to prevent peeling. Coordinate final paint color with architect. Paint materials and application requirements are specified in Division 09 painting Sections.

3.9 DUCT STORAGE / CLEANING

- A. Ductwork shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4” above the floor and shall be completely covered in plastic with no exposed ends. Installed ductwork shall be protected with plastic. Do not install the ductwork if the building is not “dried-in”. If this is required, the entire lengths of duct shall be covered in plastic for protections. The Owner / Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing NADCA certified Contractor.
- B. The working area shall be clean, dry and the ductwork protected from dust. Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.

3.10 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. All exposed ducts in spaces such as but not limited to: Gymnasiums, Natatoriums, Cafeteria's, Libraries, etc.: Double wall insulated round ductwork.
- B. Supply Ducts:
 - 1. Ducts Connected to Fan Coil Units, Split-DX System Air Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.
 - 2. Ducts Connected to Constant-Volume Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
 - 3. Ducts Connected to Variable-Air-Volume Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 6.
 - d. SMACNA Leakage Class for Round: 3.
- C. Return and Outside Air Ducts:

1. Ducts Connected to Fan Coil Units, Split-DX System Air Units Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round: 12.

 2. Ducts Connected to Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.

 2. Ducts Connected to Air-Handling and Rooftop Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round: 6.

 3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: 18-gauge Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: 16-gauge Carbon-steel sheet.
 - c. Continuously welded seams and joints
 - d. Pressure Class: Positive or negative 2-inch wg.
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - f. SMACNA Leakage Class: 3.

 4. Ducts Connected to Dishwasher Hoods:
 - a. 18-gauge Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.
 - d. Continuously welded seams and joints
 - e. Pressure Class: Positive or negative 2-inch wg.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 3.
- E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 1. Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1,000 fpm or Lower: 90-degree tap.
 - b. Velocity 1,000 to 1,500 fpm: Conical tap.
 - c. Velocity 1,500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Back-draft dampers.
 - 2. Combination fire-and-smoke dampers.
 - 3. Duct access doors.
 - 4. Fire dampers.
 - 5. Smoke dampers.
 - 6. Volume control dampers.
 - 7. Flexible duct connections
 - 8. Duct Taps
 - 9. Duct test holes
 - 10. Flexible duct elbow supports.
- B. Related Sections:
 - 1. Section 23 31 13 - Metal Duct and Casings: Requirements for duct construction and pressure classifications.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
- C. Product Data: Submit data for shop fabricated assemblies including fire dampers including locations and ratings, smoke dampers including locations and ratings, backdraft dampers, flexible duct connections, volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit for Fire, Smoke and Combination Fire/Smoke Dampers.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

1.6 COORDINATION

- A. Coordinate Work where appropriate with building control Work.
- B. Coordinate fire alarm wiring requirements with Division 26.

1.7 WARRANTY

- A. Furnish five (5) year manufacturer warranty for duct accessories.

1.8 EXTRA MATERIALS

- A. Furnish two (2) of each size and type of fusible link for fire rated dampers.

PART 2 - PRODUCTS

2.1 BACK-DRAFT DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Arrow United Industries
 - 2. American Warming and Ventilating
 - 3. Ruskin
 - 4. Air Balance
 - 5. NCA
 - 6. Pottorff
 - 7. Greenheck
- B. Product Description: Multi-Blade, back-draft dampers: Parallel-action, gravity-balanced, Galvanized 16 gage thick steel, or extruded aluminum. Blades, maximum 6-inch width, center pivoted, with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

2.2 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff
 - 6. Greenheck
- B. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S. Dampers shall be Leakage Class 1. Damper shall include a factory installed sleeve.
- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage, and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.

- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Locate damper operator on exterior of sleeve and link to damper operating shaft.
- E. Temperature rating: 250°F.
- F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure.
- G. Coordinate fire alarm control wiring with Division 26.
- H. Rating: 1-1/2 hours in wall rated at less than three (3) hours.
- I. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure, stainless steel springs with locking devices to maintain positive closure for units mounted horizontally.
- J. Electric Fuse Link: Heat actuated, quick detecting to release at 165 degrees Fahrenheit, UL listed and labeled. Controlled closing and locking of damper in 7-15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable. Manual reset at damper.

2.3 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1-inch-thick insulation with sheet metal cover.
 - 1. Less Than 12 inches square, secure with sash locks.
 - 2. Up to 18 inches Square: Furnish two hinges and two (2) sash locks.
 - 3. Up to 24 x 48 inches: Three hinges and two compression latches with outside handles.
 - 4. Larger Sizes: Furnish additional hinge.
 - 5. Access panels with sheet metal screw fasteners are not acceptable.

2.4 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Cesco
 - 2. NCA
 - 3. Ruskin
 - 4. Nailor
 - 5. Pottorff

6. Greenheck
- B. Fabricate in accordance with NFPA 90A and UL 555, and manufacturer's condition of listing. Permanently mark dampers for use in dynamic systems.
- C. Ceiling Fire Dampers: Galvanized steel, 24 gage frame and 24 gage blades with UL classified insulation if required. Provide with radiation blanket.
- D. Curtain Type Dampers: 20 gage Galvanized steel frame with interlocking 24 gage galvanized steel blades. Furnish stainless steel closure springs and latches for horizontal installations and closure under airflow conditions. Configure with blades out of air stream.
- E. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless-steel sleeve bearings and plated steel axles, 1/8 x 1/2-inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- F. Fusible Links: UL 33, separate at 165 degrees Fahrenheit.
- G. Rating: 1-1/2 hours in wall rated at less than three (3) hours.

2.5 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 1. Cesco
 2. NCA
 3. Ruskin
 4. Nailor
 5. Pottorff
 6. Greenheck
- B. Fabricate in accordance with UL 555S, Leakage Class I.
- C. Construction: Fabricate with 16 gage roll formed, galvanized steel hat-shaped channel frame. Furnish self-lubricating stainless-steel sleeve bearings and plated steel axles, stainless steel jamb seals, concealed linkage and 1/2-inch actuator shaft. Blades shall be airfoil type, 14-gauge equivalent. Blade edge seals shall be mechanically fastened to blade.
- D. Operators: UL listed and labeled two-position, fail close, electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Actuator to be mounted internally or externally as required.
- E. Temperature rating: 250°F.
- F. Coordinate fire alarm control wiring with Division 26.

2.6 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.
- B. Splitter Dampers:

1. Material: Same gage as duct to 24 inches size in both dimensions, and two gages heavier for sizes over 24 inches.
 2. Blade: Fabricate of single thickness sheet metal secured with continuous hinge or rod with end bearings.
 3. Operator: Minimum 1/4-inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
- C. Single Blade Dampers: Fabricate for duct height up to 12”.
- D. Multi-Blade Damper: Opposed blade interlocking type pattern for duct height 12” and greater. Assemble blades in galvanized frame channel with suitable hardware and linkage concealed in frame. Provide multiple section dampers for sizes larger than 48-inch x 72 inch. Provide jack shafting configuration and crossovers.
- E. Damper Blades:
1. Provide 16-gauge galvanized steel center and edge grooved blade type where velocities do not exceed 1500 FPM.
 2. Provide 14 gage galvanized steel. Roll formed airfoil blade type where velocities exceed 1500 FPM.
 3. Maximum leakage shall be 8 CFM per square foot of damper area at four (4) inches wg pressure.
- F. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or bronze bearings. Furnish closed end bearings on ducts having pressure classification over two (2) inches wg.
- G. Quadrants:
1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers that do not have actuators.
 2. On insulated ducts mount quadrant regulators on 2” standoff mounting brackets, bases, or adapters.
 3. Where rod lengths exceed 30 inches furnish regulator at both ends.
 4. Provide remote damper operators for concealed dampers. Operator shall utilize miter gears, worm gears and couplings or be cable operated. Coordinate operator trim and location with Architect / Engineer.
- H. Actuators:
1. Maximum damper area per actuator shall be 24 square feet face area.
 2. Actuators shall be two position or modulating spring return type.
 3. Duct mounted dampers shall have actuators mounted outside of air stream.
 4. Coordinate with Section 23 09 23 – Direct-Digital Control System for HVAC.

2.7 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Connector: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
 - 2. Net Fabric Width: Approximately six (6) inches wide.
 - 3. Metal: Three (3) inch wide, galvanized steel. Same gage as connecting duct.
 - 4. Install flexible connections with a minimum of one (1) inch between metal edges.
 - 5. Provide flexible duct connections at every duct connection to equipment.
- C. Application:
 - 1. Flexible duct connectors are not permitted on duct connections to internally isolated equipment. Internal isolation shall be in accordance with Section 230548.

2.8 DUCT TAPS

- A. Provide 24-gauge galvanized steel conical fittings with integral balancing damper for duct taps serving single ceiling diffuser. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- B. Provide 24-gauge galvanized steel 45 degree, rectangular to round, side takeoff fitting with integral balancing damper when airflow is less than or equal to 20 percent of main duct airflow. Balancing damper shall consist of 24 gauge, 3/8" steel axel and nylon end bearings with 2" standoff quadrant mount.
- C. Provide tee split with radius elbow when takeoff or branch duct airflow is greater than 20 percent of main duct. Square throat elbows are acceptable in areas of limited clearances. Provide splitter damper. Refer to Section 23 31 00 - HVAC Duct and Casings.
- D. Provide volume damper at all takeoffs in constant volume systems and at all takeoffs downstream of terminal units in variable volume systems.

2.9 DUCT TEST HOLES

- A. Permanent Test Holes: Factory fabricated, airtight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.
- B. Coordinate test hole locations and requirements with TAB contractor. If additional test holes are required for TAB, contractor will provide at no additional cost.

2.10 FLEXIBLE DUCT ELBOW SUPPORTS

- A. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6" – 16". Elbow supports shall be UL listed for use in return air plenum spaces.
- B. Provide elbow supports at each diffuser connection.
- C. Manufactured by Thermaflex – FlexFlow Elbow

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify rated walls are ready for fire damper installation.
- B. Verify ducts and equipment is ready for accessories.
- C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 INSTALLATION.

- A. Install in accordance with NFPA 90A and follow SMACNA HVAC Duct Construction Standards Metal and Flexible. Refer to Section 23 31 00 - HVAC Duct and Casings for duct construction and pressure class.
- B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside if motorized dampers are not shown on plans.
- C. Install duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and as indicated on Drawings. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Install minimum 8 x 8-inch size for hand access, 18 x 18-inch size for shoulder access, and as indicated on Drawings. Review locations prior to fabrication.
- D. Install temporary duct test holes required for testing and balancing purposes. Cut or drill in ducts. Cap with neoprene plugs, threaded plugs, threaded or twist-on metal caps.
- E. Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, and breakaway duct connections.
- F. Install smoke dampers and combination fire and smoke dampers in accordance with NFPA 92A.
- G. Install volume dampers at points on supply, return, outside air and exhaust systems where branches extend from larger ducts. For air systems with common return air plenum provide volume dampers in both outside air and return air ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.

2. Install aluminum volume dampers in aluminum ducts.
3. Install stainless steel volume dampers in stainless steel ducts.

3.3 DEMONSTRATION

- A. Demonstrate re-setting of fire dampers, fire and smoke dampers and smoke dampers to Owner's representative.

END OF SECTION 23 33 00

SECTION 23 33 19 - DUCT SILENCERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Duct silencers.
 - 2. Crosstalk silencers.
 - 3. Ductwork lagging.

1.3 PERFORMANCE REQUIREMENTS

- A. Sound control components are selected to maintain the sound level of space at levels not to exceed those listed below. The midpoint of Noise Criteria (NC) curves shall apply.
- B. Sound control components are designed to maintain rooms at the following maximum sound levels, in Noise Criteria (NC) as defined by HVAC Applications and ANSI S1.8.
 - 1. **Offices**
 - a. Executive: 30
 - b. Conference rooms: 30
 - c. Private: 35
 - d. Open-plan areas: 35
 - e. Computer/business machine areas: 40
 - f. Public circulation: 40
 - 2. **Schools**
 - a. Lecture and classrooms: 30
 - b. Open-plan classrooms: 35
 - 3. **Libraries: 25**
 - 4. **Theaters**
 - a. Theater: 25
 - b. Stage house: 25
 - c. Trap room: 25
 - d. Orchestra pit: 25
 - e. Rehearsal rooms: 25
 - f. Teaching studios: 30
 - g. Practice rooms: 30
 - h. Ensemble rooms: 30
 - i. Shop: 45

1.4 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.
- C. Product Data: Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.
- D. Design Data: Submit selection of each individual trap. Selection shall indicate airflow and pressure drop. Sound attenuators shall be selected based on full return airflow.
- E. Test Reports: Indicate acoustic housings meet or exceed specified sound transmission loss values.
- F. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- G. Manufacturer's Certificate: Certify silencers meet or exceed specified requirements.
- H. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of crosstalk silencers, acoustic housings, duct silencers and ductwork lagging. Record actual locations of hangers including attachment points.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with AMCA 300, ANSI S1.13, ARI 575, ANSI S12.36, standards and recommendations of ASHRAE 68.
- B. Combustion ratings for the silencer acoustic fill material shall not be greater than the following when tested to ASTM E84, NFPA Standard 255 or UL No. 723:
 - 1. Flame Spread Classification: 20
 - 2. Smoke Development Rating: 20
 - 3. Fuel Contribution: 20

1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) year's experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture,

chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.

- B. Do not deliver Equipment to the project site until progress of construction has reached the stage where sound attenuators are actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Aerosonics
 - 2. United McGill
 - 3. IAC
 - 4. Vibro-Acoustics
 - 5. Dynasonics
 - 6. Commercial Acoustics
 - 7. Ruskin
 - 8. Price
- B. Description: Sheet metal outer casing, sound absorbing fill material with coating, and inner casing of perforated sheet metal with integral interior baffles of similar construction. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Configuration:
 - 1. Tubular with inner casing and liner, aerodynamically shaped center body with nose cone and truncated tail cone, diameter and length as indicated on Drawings.
 - 2. Rectangular with lined splitters with radius nose and contoured tails. Size as indicated on Plans.
- D. Materials:
 - 1. Outer Casing: Minimum 22 gage thick galvanized steel stiffened with mastic filled lock formed seams, two (2) inch long, 11 gage button punched slip joints on both ends.
 - 2. Inner Casing and Splitters: Minimum 24 gage thick perforated galvanized steel.
 - 3. Fill: Glass fiber or mineral wool of minimum 3 lb/cu ft density with antimicrobial and erosion coatings.
- E. Rating:

1. ASTM E477 Insertion Loss and Maximum Generated Noise based on 1000 fpm Face Velocity. Performance criteria listed below based on IAC model LFM:

Insertion Loss (dB)

	Length -	Octave Band Center Frequency (Hz)						
		63	125	250	500	1000	2000	4000
Forward Flow	3 FT	4	7	13	16	15	10	9
	5 FT	6	10	17	25	25	14	11
Reverse Flow	3 FT	5	7	13	17	16	11	10
	5FT	7	12	19	27	27	14	13

Generated Noise (dB)

	Octave Band Center Frequency (Hz)							
	63	125	250	500	1000	2000	4000	
Forward Flow (all lengths)		32	24	32	25	34	39	24
Reverse Flow (all lengths)		31	30	34	35	40	45	28

2. Maximum static pressure shall not exceed 0.17 inches wg.
3. Return air silencers installed at mechanical room walls shall be sized for full design return flow to mechanical room. Outside air and exhaust air shall not be subtracted from return in order to ensure silencers operate within design parameters for all modes of operation.

2.2 CROSS-TALK SILENCERS / TRANSFER DUCT

- A. Description: Double wall sheet metal duct elbow with 1” insulation and perforated liner covering entire inside surface. Size as indicated on plans. Refer to Section 23 31 13 and detail on Plans.
- B. Casing: Construct elbow using duct gauges specified for size shown.
- C. Rating:
 1. Size transfer duct at a maximum of 500 fpm Face Velocity.
 2. Full design return air flow form space shall be used for sizing transfer ducts.
 3. Maximum static pressure loss through transfer duct shall not exceed 0.05 inches wg.

2.3 DUCTWORK LAGGING

- A. Acoustic Insulation: Two (2) inch thick, 3 to 5 lb/cu ft density glass fiber or mineral wool insulation.
- B. Covering: Gypsum board with surface weight minimum 4 lb/sq ft. All joints of covering shall be sealed as specified.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support duct silencers independent of ductwork.
- B. Install crosstalk silencers in wall. Pack and resiliently seal wall penetration.
- C. Lag ductwork at wall by wrapping with insulation and covering. Lagging of duct will be identified on the plans. Apply covering to be airtight. Do not attach covering rigidly to ductwork. Fire damper sleeve shall be lagged at wall penetration, no exception.
- D. Silencers shall be installed in accordance with manufacturer recommendations.
- E. Silencers installed in duct systems that generate excessive system effect and pressure drop shall be removed and installed correctly by contractor at no additional cost.
- F. Duct transition upstream of silencers shall be 30 degrees maximum. Duct transition downstream of silencer shall be 15 degrees maximum.
- G. Silencers shall be installed a distance of (3x duct diameter) from elbows.
- H. Silencers shall be installed a minimum of (1x duct diameter) from fan or unit outlets / inlets.
- I. Where multiple silencers are ganged together provide continuous galvanized steel nosing, crimped or button punched, on internal partitions.
- J. Silencers at mechanical room walls shall be installed with wall at midway point of casing. Pack and resiliently seal wall penetration. Silencers may be placed with overhang on either side of wall to allow coordination with trades.
- K. Silencers located at fire rated walls shall be connected to wall sleeve of damper. Provide duct lagging on damper sleeve.

END OF SECTION 23 33 19

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
 - 1. Hooded propeller roof fans
 - 2. Upblast centrifugal roof fans
 - 3. Upblast centrifugal roof fans – Grease exhaust
 - 4. Centrifugal filtered supply fans
 - 5. Inline Fans
- C. Related Sections:
 - 1. Section 23 31 00 - Metal Duct - Ducts: Product requirements for hangers for placement by this section.
 - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
 - 3. Coordinate work in this Section with Division 7.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, and ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics, and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.

- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.
- D. Balance Quality: Conform to AMCA 204.

1.6 WARRANTY

- A. Furnish one (1) year manufacturer's warranty for fans. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
 - 1. Fan Belts: Two (2) sets for each belt-driven fan.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Fans shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver Equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 HOODED PROPELLER ROOF FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
1. Greenheck
 2. Cook
 3. PennBarry
 4. Twin City
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor, bearings and drives shall be mounted on a welded tubular steel power assembly. The power assembly shall be rigidly secured to the fan housing. The powder coated steel fan housing shall include a minimum 14-gauge base with integral spun venturi and continuously welded or application of butyl tape to inside of the curb cap for maximum leak protection. The fan shall be enclosed with a minimum 18-gauge galvanized steel hood bolted to the fan housing. The hood shall have a removable top cap to allow unobstructed access to the motor and power assembly without removing entire hood. The fan outlet shall be protected from entry of foreign material by $\frac{1}{2}$ " x $\frac{1}{2}$ " galvanized steel screen. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Coating: All ungalvanized steel fan components shall be treated with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000-hour salt spray under ASTM B117 test method.
- F. Propeller: Propeller shall be a high-efficiency fabricated steel design with blades securely fastened to a minimum 7-gauge steel hub. The hub shall be keyed and locked to the fan shaft utilizing two setscrews. Propeller shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- G. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- H. Bearings: Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- I. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

- J. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- K. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.2 UPBLAST CENTRIFUGAL ROOF FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. PennBarry
 - 4. Twin City
- B. Fan shall be a spun aluminum, roof mounted, belt driven or direct drive, upblast centrifugal ventilator. Coordinate drive with fan schedule on drawings.
- C. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two-piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 14-gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- G. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- H. Belts & Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.3 UPBLAST CENTRIFUGAL ROOF FANS - GREASE EXHAUST

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. PennBarry
 - 4. Twin City
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller ventilator. Coordinate drive with fan schedule on drawings.
- C. Unit shall be constructed in accordance with UL 762. Fan shall bear the AMCA certified ratings seal for sound and air performance.
- D. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. The windband shall have a rolled bead for added strength. A two-piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An external wiring compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a 14-gauge steel power assembly. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. A one (1) inch thick, three-pound density foil back

heat shield shall be utilized to protect the motor and drive components from excessive heat. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

- E. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.
- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- G. Bearings: Heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours.
- H. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch drive must be factory set to the specified fan RPM.
- I. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- J. Accessories:
 - 1. Disconnect Switch: Coordinate with Division 26.
 - 2. Direct drive units shall be provided with motor speed control option.
 - 3. Gravity actuated back-draft damper with adjustable counterweight.
 - 4. Provide minimum 10" tall, vented curb extension.
 - 5. Provide grease trap with drain connection.
 - 6. Provide heat baffle.
 - 7. Provide Clean-Out Port.

2.4 CENTRIFUGAL FILTERED SUPPLY FAN - KITCHEN HOOD

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. PennBarry
 - 4. Twin City
- B. Unit shall be a low profile, hooded, roof mounted, belt driven or direct drive, propeller supply ventilator. Coordinate drive with fan schedule on drawings.
- C. Description: Fan shall be a side intake, roof mounted, belt driven, centrifugal filtered supply fan.
- D. Fan shall be constructed in accordance with UL 705. Fan shall bear the AMCA certified ratings seal for air performance.

- E. Construction: The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18-gauge galvanized steel, bolted to a minimum 16-gauge steel fan base with pre-punched mounting holes. Unit shall be provided with an insulated top cover and 1" washable permanent aluminum filter. Internal blower and motor assembly shall be mounted on rubber vibration isolators. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- F. Wheel: Wheel shall be DWDI centrifugal forward curved type, constructed of painted steel. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- G. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- H. Bearings: Bearings shall be permanently lubricated, sealed ball type selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- I. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- J. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- K. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be same voltage as motor in fan. Damper shall energize fan through integral end switch.
 - 2. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Factory provided disconnect switches shall be rated for outdoor use. Three phase combination disconnect/starter shall be provided by Division 26.
 - 3. Direct drive units shall be provided with motor speed control option.

2.5 INLINE FANS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. PennBarry
 - 4. Twin City
- B. Fan shall be a duct mounted, centrifugal, belt driven or direct drive, inline type supply or exhaust ventilator.
- C. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.

- D. Construction: The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
- E. Coating: For fans serving Natatoriums or corrosive environments provide epoxy coating on all inside and outside surfaces including fan wheel and pulley.
- F. Wheel: The fan wheels shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
- G. Motor: Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase, and enclosure. Motor Pulleys shall be adjustable for system balancing.
- H. Bearings: Precision ground and polished shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum catalogued operating speed.
- I. Belts & Drives: Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
- J. Accessories:
 - 1. Disconnect Switch: Coordinate with Division 26. Provide factory wired disconnect switch on 120v motor only. Three phase combination disconnect/starter shall be provided by Division 26.
 - 2. Gravity actuated back-draft damper with adjustable counterweight.
 - 3. Direct drive units shall be provided with motor speed control option.
 - 4. Companion Flanges: For inlet and outlet duct connections.
 - 5. Fan Guards: 1/2 by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 - 6. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.2 INSTALLATION

- A. Secure roof fans with cadmium plated steel lag screws to roof curb structure.
- B. Install power ventilators level and plumb.

- C. Install dampers in roof curb damper tray.
- D. Provide hinged curb adapter to permit access to dampers and duct connection.
- E. Install safety screen where inlet or outlet is exposed.
- F. Provide sheaves required for final air balance.
- G. Install units with clearances for service and maintenance.
- H. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.3 CLEANING

- A. Vacuum clean inside of fan cabinet.

3.4 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.5 PROTECTION OF FINISHED WORK

- A. Do not operate fans until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

END OF SECTION 23 34 00

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single duct air terminal units
- B. Related Sections:
 - 1. Section 23 09 23 – Direct Digital Controls: Controls remote from unit.
 - 2. Section 23 09 93 – Sequences of Operation for HVAC System.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
- C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work within shop coordination drawings.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- D. Delegated-Design Submittal:
 - 1. Materials, fabrication, assembly, and spacing of hangers and supports.

- E. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Size and location of initial access modules for acoustic tile.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in "Operation and Maintenance Data," include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software set points.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Test and rate air terminal unit performance for air pressure drop, flow performance, and acoustical performance in accordance with ARI 880 and ARI 885. Attach ARI seal to each terminal unit.
- C. All electrical components shall be UL Listed and installed in accordance with the National Electric Code. Electrical connections to terminal units shall be single point. The energy terminal shall be UL Listed as a complete assembly.
- D. LEED Prerequisite EQ 1 requires compliance with requirements in ASHRAE 62.1, including requirements for controls, surfaces in contact with the airstream, particulate filtration, finned-tube coil selection and cleaning, and equipment access. Verify, with manufacturers, availability of units with components and features that comply with these requirements.
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Filters shall be provided by air terminal unit manufacturer and not by the mechanical contractor.
 - 1. Fan-Powered-Unit Filters: Furnish [one] 1 spare filter(s) for each filter installed.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

1.8 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.9 COORDINATION

- A. Coordinate Work with Section 23 09 23 - Direct-Digital Control System for HVAC.

1.10 WARRANTY

- A. Furnish one (1) year manufacturer warranty for air terminal units. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Air Terminal Units shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 SINGLE DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Titus
 2. Price
 3. Nailor
 4. Metalaire
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Identification: Furnish each air terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.
- D. Casing: Minimum 22-gauge galvanized steel.
1. Casing Lining: Fiber free, 1/2-inch thick, engineered polyurethane foam, 1.5 lb. / cu. ft. insulation complying with NFPA 90A, UL 181 erosion requirements, UL 181 Mold Growth and Humidity, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84. Exposed fiberglass is not acceptable. The casing shall be designed for hanging by 10-gauge sheet metal hanger brackets for suspending unit with threaded rod.
 2. Air Inlets: Round stub connections or oval connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- E. Volume Damper: Heavy gauge galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
 2. Damper Position: Normally open.
- F. Velocity Sensors: Multi-point array, center-averaging differential pressure, with velocity sensors in air inlets and air outlets. Sensors that deliver the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.
- G. Actuators shall be capable of supplying at least 35 inches per pound of torque to the damper shaft and shall be mounted externally for service access.

- H. Factory installed hydronic heating coils (where scheduled): Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

- I. Factory installed Electric-Resistance Heating Coils (where scheduled): Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
 - 1. Provide 480v / 3ph / 60Hz 4W wye single point power connection.
 - 2. Stage(s): Refer to schedule.
 - 3. Access door interlocked non-fused disconnect switch.
 - 4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 - 5. Nickel chrome 80/20 heating elements.
 - 6. Airflow switches for proof of airflow.
 - 7. Fan interlock contacts.
 - 8. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 - 9. Magnetic contactor for each step of control (for three-phase coils).

- J. Factory-Mounted and Wired Controls: Electrical components mounted in control box with removable cover. Incorporate single-point electrical connection to power source for terminal units with electric heat.
 - 1. Control Transformer (Required only for terminal units with electric heat): Factory mounted for control voltage. Coordinate equipment voltage requirement with electrical plans.
 - 2. Wiring Terminations: Coordinate required wiring diagrams with Building Automation System controls subcontractor.
 - 3. The following equipment items are to be furnished by Specification Section 23 09 23 - Direct-Digital Controls and installed by air terminal unit manufacturer.
 - a. Auto temperature control card (DDC).
 - b. 24-volt damper actuator.
 - 4. The following equipment items are to be furnished and installed by the air terminal unit manufacturer:
 - a. Volume Control Damper.
 - b. Multi-point flow sensor.
 - c. Controller enclosure.
 - d. Power transformer; required only for terminal units with electric heat. (Coordinate voltage with electrical plans).

- K. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.
- L. Sound Ratings: Not to exceed 35 NC at one (1) inch static pressure. Sound performance shall be ARI certified.
 - 1. Maximum discharge sound power level of 62 DB.
 - 2. Maximum radiated sound power level of 70 DB.
 - 3. DB level based on third octave band.
- M. Temperature sensor provided, wired, and installed by Building Automation System Control Contractor: Refer to Section 23 09 23 – Direct Digital Controls.
- N. For Sequence of Operation: Refer to Section 23 09 93.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install ceiling access doors or locate units above easily removable ceiling components.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

- A. Install electrical power adjacent to air terminal unit to allow service and maintenance.
- B. Connect ducts to air terminal units according to Section 23 31 13 "Metal Ducts."
- C. Coordinate duct installations and specialty arrangements with Drawings.
- D. Make electrical connections to air terminal units with connectors complying with requirements in Division 26.

3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

3.8 ADJUSTING

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to 0 percent full flow. Set units with Electric Heating coils for minimum 50 percent full flow.

END OF SECTION 23 36 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Air devices.

1.3 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.
- C. Test Reports: Rating of air outlet and inlet performance.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of air outlets and inlets.

1.6 QUALITY ASSURANCE

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.

- B. Test and rate louver performance in accordance with AMCA 500.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Air Devices shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

2.1 AIR DEVICES

- A. Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. Titus
 - 2. Price
 - 3. Nailor
 - 4. Metalaire
- B. Mounting:
 - 1. Plaster Surfaces: Provide with plaster frames or plaster rings to make airtight seal against mounting surface.
 - 2. "T" Bar Ceilings: Lay-in type.
 - 3. Gyp Board and Wall surfaces: 1-1/2" overlap flange.
- C. Fire rated diffusers for fire rated roof/ceiling assembly: Refer to diffuser schedule for fire rated assembly requirement.

1. UL classified fire rated ceiling diffuser assembly listed in The Underwriters Laboratories "Fire Resistance Directory".
 2. Shall have a fire resistance rating of 3 hours.
 3. Heavy Gauge Steel Diffusers shall be tested in accordance with UL 263 and must meet NFPA 90A requirements. Diffusers must be able to operate in (3) three-hour fire rated ceiling and must be installed in accordance with the installation instructions.
 4. UL 555C Fire resistance rating: 3-hour ceiling radiation damper with fusible link assembly. Fire closure temperature of 165°F.
 5. UL listed thermal blanket insulation, mineral fiber around entire diffuser.
 6. Complete fire rated damper assembly with blanket shall be provided and submitted by/with Diffusers, Registers, and Grilles.
- D. Source Quality Control
1. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."
- E. Accessories:
1. Square to round neck adapter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify inlet and outlet locations.
- B. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Verify ceiling and wall systems are ready for installation.
- E. Refer to Architectural Code Information and Fire Rated Assemblies Drawing to verify if ceiling is fire rated. If ceiling is fire rated provide U.L. tested radiation damper with thermal blanket for all ceiling mounted supply and return air grilles.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00 – Air Duct Accessories.

- C. Install diffusers, registers, and grilles level and plumb.
- D. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- E. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- F. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 91 00.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.5 SCHEDULES:

- A. Refer to Drawings.

END OF SECTION 23 37 13

SECTION 23 37 23 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide complete, fully operational fans where indicated on Drawings.
- B. Section Includes:
 - 1. Dryer vent roof cap
 - 2. Roof mounted intake hood
 - 3. Roof mounted relief hood
- C. Related Sections:
 - 1. Section 23 31 13 - Metal Duct: Product requirements for hangers for placement by this section.
 - 2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
 - 3. Coordinate work in this Section with Division 7.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork, and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics, and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705 and UL 762 for kitchen exhaust.
- D. Balance Quality: Conform to AMCA 204.
- E. Energy Recovery Unit Wheel Energy Transfer Rating: Meet ARI 1060.

1.6 WARRANTY

- A. Furnish one (1) year manufacturer's warranty. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up will not be acceptable.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Ventilators shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- B. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.
- C. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- D. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS.

2.1 DRYER VENT ROOF CAP

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. PennBarry
- B. Unit shall be a spun aluminum, roof mounted gravity ventilator.

- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The spun aluminum baffle shall have a rolled bead for added strength. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories: Gravity actuated back-draft damper with adjustable counterweight.

2.2 ROOF MOUNTED INTAKE HOOD

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. PennBarry
 - 4. Twin City
- B. Unit shall be an aluminum roof mounted intake hood.
- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 14-gauge marine alloy aluminum, bolted to a minimum 8-gauge aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. Birdscreen constructed of 1/2" mesh shall be mounted across the intake opening. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories:
 - 1. Motorized damper in damper tray of roof curb. Actuator shall be low voltage for control wiring from DDC controller. Damper shall include integral end switch.

2.3 ROOF MOUNTED RELIEF HOOD

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Greenheck
 - 2. Cook
 - 3. PennBarry
 - 4. Twin City

- B. Unit shall be an aluminum roof mounted relief hood.
- C. Construction: The unit shall be of bolted and welded construction utilizing corrosion resistant fasteners. The aluminum hood shall be constructed of minimum 14-gauge marine alloy aluminum, bolted to a minimum 8-gauge aluminum support structure. The aluminum base shall have sealed curb cap corners by continuous weld or application of butyl tape to inside of the curb cap for maximum leak protection. Bird screen constructed of 1/2" mesh shall be mounted across the intake opening. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Roof Curb: 12-inch-high of 18-gauge galvanized steel construction with continuously welded seams, built-in cant strips, 1-1/2-inch insulation, damper tray, hinged curb adapter for access to dampers, and factory installed nailer strip. Coordinate installation with Division 7.
- E. Accessories:
 - 1. Gravity actuated back-draft damper with adjustable counterweight.
 - 2. Motorized damper: actuator shall be low voltage for control wiring from DDC controllers. Damper shall include integral end switch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.2 INSTALLATION

- A. Secure intake/relief hoods with cadmium plated steel lag screws to roof curb structure.
- B. Install dampers in roof curb damper tray.
- C. Provide hinged curb adapter to permit access to dampers and duct connection.
- D. Install safety screen where inlet or outlet is exposed.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Furnish services of factory trained representative for minimum of one (1) day to start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.4 CLEANING

- A. Vacuum clean inside of fan cabinet.

3.5 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.6 PROTECTION OF FINISHED WORK

- A. Do not operate until ductwork is clean, bearings are lubricated, and fan has been test run under observation.

END OF SECTION 23 37 23

SECTION 23 73 13 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes modular factory fabricated air-handling units and accessories.
- B. Related Sections:
 - 1. Section 23 05 00 - Common Work Results for HVAC.
 - 2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.
 - 3. Section 23 07 16 - HVAC Equipment Insulation: Product requirements for insulation for placement by this section.
 - 4. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.
 - 5. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors for placement by this section.
 - 6. Section 23 05 14 - Variable Frequency Controllers.

1.3 SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Provide line-by-line schedule notes review annotated to certify compliance or deviation.
- C. Provide Footprint Square Footage Discrepancy Chart in spreadsheet form. Clearly show the differences in height, length, and width between the submitted units and designed units per plans for each AHU with corresponding tag.
- D. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- E. Product Data, Submit the following:
 - 1. Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
 - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.

3. Fans: Performance and fan curves with specified operating point plotted, power, RPM.
 4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity per ARI 260.
 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
- F. Manufacturer's Installation Instructions: Submit.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. Comply with NFPA 70.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three (3) years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Equipment shall be factory wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Protection of the complete unit from rusting and water migration must be handled as best suits the circumstances. Store in a place protected from construction traffic and weather.
- A. All equipment shall remain in manufacturer's protective shipping wrap during construction. Openings must remain protected and covered during construction. If

protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

- B. Contractor shall adequately protect equipment from damage after delivery to the project. Equipment shall be completely covered and secured with heavy tarpaulins, drop cloths or other protective coverings as required to protect from inclement weather, moisture, chemicals, construction traffic, plaster, paint, mortar and/or dirt. Do not cover with plastic materials and trap condensate and cause corrosion. Protective covering is in addition to the manufacturer's original factory packaging. Original factory packaging shall not be deemed as acceptable protection of equipment.
- C. Do not deliver equipment to the project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather will be rejected, and the contractor is obligated to furnish new equipment of like kind at no additional cost to the Owner. Limit shipment of bulk and multi-use materials to quantities needed for immediate installation.
- D. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- E. Protect units from physical damage. Leave factory covers in place until startup of machine.

1.8 WARRANTY

- A. Furnish one (1) year manufacturer parts and labor warranty for air handling units. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start up is not acceptable.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor or "by others".
 - 1. Filters: Furnish three (3) sets for each unit. One set during construction, a new set of filters for Test and Balancing services, and final new set at substantial completion. Filters shall be protected with polyester fabric at all times during construction.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

PART 2 - PRODUCTS

2.1 MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

- A. Manufacturers: Subject to compliance with scheduled efficiencies, capacities, and specification, provide products by the following manufacturers.
 - 1. Carrier
 - 2. Daikin
 - 3. Temtrol
 - 4. Trane
 - 5. York/JCI
- B. Configuration: Coordinate with project plans and schedules.
- C. Performance Base: Sea level pressure or altitude.
- D. Fabrication: Conform to AMCA 99 and ARI 430. Units shall be factory assembled and ship in one piece where possible. Shipping splits are acceptable provided manufacturer includes gaskets and bolts.

2.2 SPECIAL PROJECT REQUIREMENTS: CONSTRUCTION

- A. In order to demonstrate energy compliance with IECC, performance method; the project as specified and scheduled was energy modeled and complies. Alternate manufacturers are allowed but must not exceed maximum scheduled brake horsepower, efficiency, etc.
- B. Air handling units shall be constructed to fit scheduled maximum dimensions including factory built mixing boxes and must maintain minimum specified access sections as scheduled and shown on plans. Rotating units to different orientations other than what is drawn on plans will be unacceptable. If potentially submitted equipment shall exceed any scheduled dimension, manufacturer shall provide performance data and dimensional data for consulting engineer to review and determine if proposed unit will fit within allotted space and maintain all required maintenance clearance. Equipment with deviations to dimensions shall be submitted 10 days prior to bid date for review.
- C. Outside air / return air mixing boxes shall be factory fabricated with the same construction as the unit casing. Field supplied or installed mixing boxes are not acceptable. Dampers shall be factory installed on mixing box openings. Actuators shall be provided by the control's contractor. This applies to all the air handling units with energy recovery wheel.
- D. Where total energy recovery wheels are scheduled to be provided, the energy recovery wheels shall be factory fabricated and within its own modular section with the same construction as the unit casing. The energy recovery wheel modular section shall have the same height and width as the associated fan and coil section. Any mismatched height or width dimension or any stand-alone energy recovery wheel section will not be accepted.

2.3 CASING

- A. Full perimeter welded double-bottom steel base assembly constructed with a minimum of 14-gauge galvanized steel and shall be a minimum of six (6) inches in height. Base assembly shall be thermally broken and insulated with a minimum of 2" thick, R-13 closed-cell sprayed foam. Assemble multiple sections that are shipped loose with gaskets, caulk, and bolts per the manufacturer's installation instructions.

- B. Outside Casing:
1. Galvanized Steel: 18-gauge G90 with fiberglass insulation or 20-gauge G90 if expanded foam injected insulation is utilized.
- C. Inside Casing:
1. Galvanized Steel: Solid 20-gauge G90. Provide 20-gauge perforated panels in fan section and discharge plenum.
- D. Casing shall be supported by free-standing 16-gauge G90 structural frame with removable panels. Framing members shall have thermal break and injected with expanded foam insulation. Structural integrity of frame shall not be affected by removing panels. Top, bottom, and side panels shall be of one-piece double-wall construction, formed and reinforced to provide a rigid assembly. All panels shall be completely gasketed at factory with a minimum 1/4-inch-thick x 3/4 inch wide closed-cell neoprene. Top and side panels shall be easily removable for service.
- E. Insulation: Glass fiber or Expanded Foam.
1. 'K' (Ksi) factor at 75 degrees Fahrenheit: Maximum 0.154 Btuh inch / sq. ft. / degrees Fahrenheit.
 2. Density: Two (2) inch thick, minimum 1-1/2 lbs. /cu ft. throughout the entire unit. One (1) inch thick casing panels in any section is unacceptable.
 3. Insulation in perforated sections shall be coated on air side to prevent erosion into air stream. Uncoated insulation is unacceptable.
 4. If air unit structural frame comes into contact with conditioned air, it shall be insulated with the same material throughout the rest of the unit.
- F. Access Section (All AHUs except AHUs with ERW): Minimum 24" access section with minimum 19" door clearance of double wall galvanized steel construction for flush mounting, with gasket, latch, and handle assembly, same thickness as casing. Access door frame shall be extruded aluminum, foam filled with a thermal break barrier, and include a full perimeter gasket. All access doors shall match unit casing construction, include a thermal break, and a factory installed sealable test port equal to Ventfabrics model 699. Provide access section between parallel coil sections, upstream of coil sections, upstream and downstream of the energy recovery wheels, in fan sections, filter sections, and mixing boxes.
- G. Access Section (AHUs with ERW): Minimum 18" access section with full width access door double wall galvanized steel construction for flush mounting, with gasket, latch, and handle assembly, same thickness as casing. Access door frame shall be extruded aluminum, foam filled with a thermal break barrier, and include a full perimeter gasket. All access doors shall match unit casing construction, include a thermal break, and a factory installed sealable test port equal to Ventfabrics model 699. Provide access section between parallel coil sections, upstream of coil sections, upstream and downstream of the energy recovery wheels, in fan sections, filter sections, and mixing boxes.
- H. Cooling Coil Drain Pan: Welded double wall, type 304 stainless steel IAQ pan with two (2) inch insulation and welded corners. Drain pans without welded corners are not acceptable. Cross break and pitch to drain connection. Cooling coils with a finned height greater than 48 inches shall have an intermediate stainless steel IAQ drain pan extending entire length of coil. Intermediate pan shall have a minimum of two drop tubes to main

pan. Drain pans shall allow no standing water and comply with ASHRAE Standard 62. Drain pans must be accessible for cleaning.

- I. Strength: Furnish structure to brace casings for suction pressure of five (5) inch wg, with maximum deflection of 1 in 200.

2.4 FANS

- A. Type: Refer to Air Handling Unit Schedule for fan type and drive type.
 1. Direct drive plenum fans shall be single width single inlet type with backward inclined airfoil blades. Plenum fan wheel, airfoil blades and hub shall be constructed from aluminum.
- B. Fan shall be statically and dynamically balanced at the factory as a complete fan assembly.
- C. The Fan wheels shall be keyed to shaft to prevent slipping.
- D. Construction: AMCA Class II minimum.
- E. Performance Ratings: Conform to AMCA 210 and label with AMCA Certified Rating Seal.
- F. Sound Ratings: Tested to ARI 260 and label with Certified Sound Rating Seal.
- G. Bearings: Provide permanently lubricated bearings.
- H. Mounting: Locate fan and motor internally on welded or bolted steel base coated with corrosion resistant paint or rust-resistant G90 steel and factory-mounted motor on slide rails. Furnish access to motor, drive, and bearings through hinged access doors. Mount base on vibration isolators with deflections in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment or 2" deflection, whichever requirement is stricter.
- I. Fan Modulation: Variable frequency drive.
- J. Fan Motors: All motors shall be premium efficiency, NEMA MG-1 Section 3, Inverter Duty. Refer to Specification 23 05 13 - Common Motor Requirements for HVAC Equipment for acceptable motor manufacturers.
- K. Flexible Connection: Provide internal flexible connection between fan and air unit casing. Flexible connection between air unit casing and connecting duct shall not be provided when fan is internally isolated with flexible connection to casing.
- L. **All fans shall be provided with zero net effect vertical backdraft dampers. These non-controlled dampers shall provide for isolation in event a fan fails or is turned off and to prevent filters from being pulled into the fan section.**

2.5 BEARINGS AND DRIVES

- A. Bearings: Pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA 9 L-10 life at 200,000 hours.

- B. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated to prevent corrosion.
- C. Motor Shaft Grounding Kit: For all AHU motors, a motor shaft grounding kit shall be provided. This shall be factory installed prior to shipment. If not available from the factory, manufacturer is responsible for providing kits and field installation with no additional cost to owner or contractor.
- D. Motor: Motor shall be non-overloading. Motor horsepower shall be sized at a point on fan curve resulting from 105 percent of design RPM at scheduled CFM with a reduction in static pressure of 0.5-inch wg. All fan motors shall be in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

2.6 COILS

- A. Provide access doors upstream and downstream of coils. Enclose coils with headers and return bends fully contained within casing. Slide coils into casing through removable end panel with blank-offs and casing sealing grommets at connection penetrations. Coils shall be supported by stainless steel coil support members maintaining a minimum of 1" separation between bottom of coil casing and drain pan.
- B. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.
- C. Water Cooling Coils:
 - 1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
 - 2. Configuration: Drainable, with threaded plugs for drain and vent; threaded plugs in return bends and in headers opposite each tube.
 - 3. Coils shall be a maximum of eight (8) rows deep.
 - 4. 18-inch access section between parallel coil faces.
 - 5. Casing: Die formed channel frame of 16-gauge type 304 stainless steel.
 - 6. Drain Pans: Extend 12 inches downstream of coil and for coil banks more than 48 inches high provide intermediate pan with down spouts.
 - 7. Tubes: 5/8-inch OD seamless copper expanded into fins, brazed joints. Minimum tube thickness shall be 0.020" copper.
 - 8. Fins: Aluminum, maximum of 10 fins per inch. Minimum fin thickness shall be 0.008" aluminum.
 - 9. Coil supports shall be 16-gauge type 304 stainless steel.
- D. Tube Velocities: Coil tube design velocity shall be between 2 feet and 5 feet per second and also maintain design water side temperature difference down to 30 percent flow through coil. Provide tubes that are enhanced internally if minimum initial design tube velocity cannot be obtained

E. Refrigerant Cooling Coils:

1. Coils shall be designed for use with R-410a, as indicated on schedule.
2. Coils shall be intertwined; split-faced coils not acceptable.
3. Configuration: Sweat type copper suction connections located at the bottom of the suction headers for gravity oil drainage.
4. Coils shall be a maximum of eight (8) rows deep.
5. 18-inch access section between parallel coil faces.
6. Casing: Die formed channel frame of stainless steel.
7. Drain Pans: Extend 12 inches downstream of coil and for coil banks more than 48 inches high provide intermediate pan with down spouts.
8. Tubes: 5/8-inch OD seamless copper, 0.020" thick, expanded into fins, brazed joints.
9. Fins: Aluminum, 0.008" thick, maximum of 10 fins per inch.
10. Coil supports shall be 16-gauge type 304 stainless steel.

F. Electric Heating Coils:

1. Refer to Air Handling Unit Schedule for Heating kW capacity.
2. Casing Assembly: Flanged type with galvanized-steel frame.
3. Sheathed Heating Elements: Coiled resistance wire of 80 percent nickel and 20 percent chromium surrounded by compacted magnesium-oxide powder in tubular-steel sheath; with spiral-wound, copper-plated, steel fins continuously brazed to sheath.
4. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.
5. The Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.
6. The manufacturer shall furnish an integral control box containing thermal cutouts, primary control, subcircuit fusing, airflow proving switch, and fused control transformer.
7. Electric heaters shall be UL listed for zero clearance and shall meet all applicable National Electric Code requirements.

8. The Units with electric heat sections shall be listed under UL 1995 Standard for Safety.

2.7 TOTAL ENERGY RECOVERY WHEEL UNIT

- A. Manufacturers: Subject to compliance with scheduled efficiencies, capacities, and specification, provide products by the following manufacturers.
 1. SEMCO
 2. Innergytech
- B. Provide energy recovery wheel where scheduled.
- C. Casing construction shall be the same as the rest of the unit.
- D. Total energy recovery wheel shall be installed by air unit manufacturer at the factory prior to shipment and shall be an integral component of the fully assembled unit. Loose or separate wheel sections shall not be acceptable.
- E. Energy recovery wheel shall be constructed of corrugated media, with a desiccant intimately bound and uniformly and permanently dispersed throughout the matrix structure of the media. Rotors with desiccants coated bonded or synthesized onto the media are not acceptable due to delaminating or erosion of the desiccant material.
- F. Media shall be resistant to corrosion resistance and resistance against attack from laboratory chemicals present in pharmaceutical, hospital, etc. environments as well as attack from external outdoor air conditions. Face flatness of the wheel shall be maximized in order to minimize wear on inner seal surfaces and to minimize cross leakage.
- G. Rotor shall be constructed of alternating layers of flat and corrugated media.
- H. Wheel layers should be uniform in construction forming uniform aperture sizes for airflow. Wheel construction shall be fluted or formed honeycomb geometry so as to eliminate internal wheel bypass. Wheel layers that can be separated or spread apart by airflow are unacceptable due to the possibility of channeling and performance degradation.
- I. The minimum acceptable performance shall be as specified in the unit schedule.
- J. Desiccant Material: The desiccant material shall be a molecular sieve, and specifically **3A molecular sieve** to minimize cross contamination.
- K. Wheel Media Support System: The wheel frames shall consist of evenly spaced steel spokes, galvanized steel outer band and rigid center hub. The wheel construction should allow for post fabrication wheel alignment.
- L. Wheel Seals: The wheel seals shall be full contact nylon brush seals or equivalent. Seals should be easily adjustable.
- M. Wheel cassette: Cassettes shall be fabricated of heavy duty reinforced galvanized steel or welded structural box tubing. Cassettes shall have a built-in adjustable purge section minimizing cross contamination of supply air as shown on unit schedule.
- N. Bearings shall be inboard, zero maintenance, permanently sealed roller bearings, or alternatively, external flanged or pillow block bearings.

- O. Drive systems shall consist of fractional horsepower AC drive motors with multi-link drive belts.
- P. Face and bypass dampers shall be furnished as shown on unit schedule and drawings.
- Q. The wheel shall be listed or recognized by UL or equivalent.
- R. Provide a factory installed and wired variable frequency drive (VFD) controller that shall support full economizer and frost protection modes. Control system shall include factory mounted and wired temperature sensors in all four airstreams. The VFD shall be mounted in a NEMA 1 enclosure, include an LCD display screen, allow for an 80:1 turndown ratio, and communicate to the BAS via BACnet MS/TP.

2.8 FILTERS

- A. Filter Box: Section with filter guides, access doors as shown on plans, for side loading with gaskets and blank-off plates.
- B. Filter Frames: Pad holding frames shall be permanent metal frames designed to contain replaceable filter media pads. Frames shall be constructed of 22-gauge, galvanized steel U channel cell sides, expanded metal support grid, 9-gauge hinged retainer gate, sized to fit in standard universal holding frames, and accept maximum 2" thick media. Acceptable manufacturers: AAF or pre-approved equal.
- C. Replaceable Filter Media: MERV 13 or greater rating in accordance with ASHREA Test Standard 52.2-2007.
- D. High-Capacity Angle Filter: Two (2) inch extended area filters. Air quantities as scheduled; clean pressure drop of 0.10 inches wg; dirty pressure drop of 0.75 inches wg.
- E. Filter Area: Max velocity of 350 FPM.
- F. Filter Gauges: Provide Dwyer 2000 (photohelic) magnehelic gauges, 4" diameter and shall be accurate to $\pm 2\%$ of full range. One gauge shall be provided for each filter bank. Gauges shall be recessed into cabinet casing.

2.9 CONTROLS

- A. Controls: Refer to Section 23 09 23 - Direct-Digital Control System for HVAC.

2.10 CAPACITY

- A. Performance: Provide equipment as scheduled on Drawings.

2.11 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Provide equipment with electrical characteristics as shown on Electrical Drawings.
- B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Requirements for motors.
- C. Section 23 05 14 - Variable Frequency Controllers: Requirements for drives.

- D. Combination Starter-Disconnect Switch: Provided by Division 26.
- E. Junction Box: Factory provided, mounted, and wired junction boxes on each fan section. J-box shall allow electrical contractor to connect power to device without penetrating through cabinet. Field installed J-boxes will not be acceptable; it shall be the complete responsibility of the manufacturer to install. Units shall be shipped with J-boxes pre-wired and mounted. Within equipment submittal the manufacturer shall show J-box location on plan view dimensional drawing.
- F. Motor Overload Panel: For units with more than one fan, and to allow for a connection to a single variable frequency drive, provide a factory mounted and wired motor overload panel. Panel shall be UL listed, NEMA 1 enclosure with IECC manual starters with rotary type operators and auxiliary contacts.
- G. All starters shall be equipped with integral phase-failure relay (automatic resetting type) to shut down motor upon loss of an electrical phase.

2.12 SOURCE QUALITY CONTROL

- A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.
- B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."
- C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.
- D. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with ARI 430.
- B. Install assembled units with internal vibration isolators. Internally isolated fans shall be provided with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating. Refer to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Equipment Mounting: Install air-handling units on concrete bases using elastomeric pads. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases; Comply with requirements for vibration isolation devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Contractor to provide fixed sheaves required for final air balance as dictated by Test and Balance Contractor.
- E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

- F. Insulate coil headers located outside airflow as specified for piping. Refer to Section 23 07 19 - HVAC Piping Insulation.
- G. Provide trapped condensation drain line routed to the nearest floor drain. Refer to detail on Drawings and Section 23 21 13 - Hydronic Piping.
- H. Installation of Hot Water Heating and/or Chilled Water Coil:
 - 1. Make connections to coils with unions. Position unions to permit coil removal.
 - 2. Connect water supply to leaving airside of coil (counter flow arrangement).
 - 3. Locate water supply at bottom of supply header and return water connection at top.
 - 4. Install water coils to allow draining and install drain connection at low points.
 - 5. Install the following piping accessories on piping connections. Refer to Section 23 21 13 - Hydronic Piping.
 - a. On supply: (refer to coil connection details)
 - 1. Thermometer well and thermometer.
 - 2. Well for control system temperature sensor.
 - 3. Shutoff valve.
 - 4. Pressure gage.
 - 5. Strainer
 - b. On return: (refer to coil connection details)
 - 1. Air vent.
 - 2. Thermometer well and thermometer.
 - 3. Well for control system temperature sensor.
 - 4. Pressure gage.
 - 5. Modulating control valve (by BAS).
 - 6. Combination balancing / shut-off globe valve with memory stop and pressure / temperature ports.
 - 7. Shutoff valve (provided by mechanical contractor in addition to balancing valve).
 - 6. Install valves and piping specialties in accordance with details as indicated on Drawings.
 - 7. Install manual air vents at high points complete with shutoff valve. Refer to Section 23 21 13 - Hydronic Piping.
 - 8. Install floor support stands at piping drops to air unit coil connections. Air unit coil shall not carry any suspended piping load.
- I. Air unit manufacturer representative shall remove vibration isolation shipping blocks prior to start-up and ensure that fan base is free floating, and isolators are not short-circuited during operation.

3.2 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to air-handling unit to allow service and maintenance.
- D. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- E. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.
- F. Coordinate duct installations and specialty arrangements with schematics on Drawings and with requirements specified in Section 23 31 13 "Metal Ducts" and Section 23 33 00 "Air Duct Accessories."
- G. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 23 33 00 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
 - 2. Charge refrigerant coils with refrigerant and test for leaks.
 - 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3.4 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.

3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
 6. Verify that zone dampers fully open and close for each zone.
 7. Verify that outdoor- and return-air mixing dampers open and close and maintain minimum outdoor-air setting.
 8. Comb coil fins for parallel orientation.
 9. Verify that proper thermal-overload protection is installed for electric coils.
 10. Install new, clean filters.
 11. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- B. Starting procedures for air-handling units include the following:
1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
 2. Measure and record motor electrical values for voltage and amperage.
 3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.5 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.6 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units externally and internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, comb coils, drain pans, and filter housings, and install new, clean filters.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

3.8 PROTECTION OF FINISHED WORK

- A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.
- B. All air units shall remain in manufacturer's protective shipping wrap during construction. Air unit casing openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

END OF SECTION 23 73 13

SECTION 23 81 26 - DUCTLESS MINI-SPLIT-SYSTEM AIR-CONDITIONERS

PART I -GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL REQUIREMENTS

- A. Indoor, wall or ceiling mounted, direct-expansion fan coils are matched with cooling only outdoor unit.
- B. Outdoor air-cooled split system compressor sections suitable for on-the-ground, rooftop, wall hung or balcony mounting. Units shall consist of a rotary compressor, an air-cooled coil, propeller-type draw-through outdoor fan, metering device(s), and control box. Units shall discharge air horizontally as shown on the contract drawings. Units shall function as the outdoor component of an air-to-air cooling only or heat pump system (refer to schedule).
- C. Indoor unit shall be rated per ARI Standards 210/240 and listed in the ARI directory as a matched system.
- D. A factory provided and installed BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the system from an operator workstation. Control features available, and monitoring points displayed, locally at fan coil controller shall be available through building automation system.
- E. Outdoor unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC. Units shall be evaluated in accordance with UL standard 1995. Units shall be listed in the CEC directory. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061). Air-cooled condenser coils shall be leak tested at 573 psig.
- F. Provide equipment with electrical characteristics as shown on the Electrical Drawings.

1.3 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with plans and specification, provide one of the following:
 - 1. LG.
 - 2. Carrier.
 - 3. Daikin.
 - 4. Mitsubishi/Trane.

1.4 SUBMITTAL:

- A. Submit in form similar to the schedule on the Drawings. Show all data listed in schedule,

- electrical characteristics and accessories being provided.
- B. Provide line-by-line specification review annotated to certify compliance or deviation.
- C. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures.
- D. Product Data: Submit product data, including manufacturer's □product sheet for specified products.

1.5 WARRANTY

- A. One (1) year on unit parts other than compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.
- B. Five (5) years on compressor/motor assembly. Warranty shall begin from date of Certificate of Substantial Completion.
- C. One (1) year on refrigerant and oil. Warranty shall begin from date of Certificate of Substantial Completion.

PART 2 –PRODUCTS

2.1 UNIT CABINET:

- A. Indoor unit cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance.
- B. Outdoor unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked-enamel finish on inside and outside. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.
- C. Indoor and outdoor unit shall be of the same manufacturer.

2.2 COMPRESSOR

- A. Compressor shall be fully hermetic rotary type. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere. Compressor assembly shall be installed on rubber vibration isolators.

2.3 COIL

- A. Evaporator coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap.
- B. Condenser coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.

2.4 FANS

- A. Fan shall be tangential direct-drive blower type with air intake at the top of the unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be provided standard. Air sweep operation shall be user selectable. The vertical sweep may be adjusted (using the remote control) and the horizontal air direction may be set manually.

2.5 AIR FILTERS

- A. Unit shall have filter track with factory-supplied cleanable filters.

2.6 BUILDING AUTOMATION SYSTEM INTERFACE:

- A. Controls shall consist of a microprocessor-based control system which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 62° F to 84°F.
- B. The unit shall have integral controls provided by unit manufacturer to perform input functions necessary to operate the system. Factory installed hardware and software to enable building automation system to monitor, control, and display status and alarms.
 - 1. A factory provided and installed BACnet communication interface card with building automation system shall enable building automation system operator to remotely control and monitor the system from an operator workstation. Control features available, and monitoring points displayed, locally at fan coil controller shall be available through building automation system.
 - 2. The unit shall be compatible with interfacing with connection to BACnet networks or interfacing with connection to BMS system.
- C. The unit shall have the following functions as a minimum:
 - 1. An automatic restart after power failure at the same operating conditions as at failure.
 - 2. A timer function to provide a minimum 24-hour timer cycle for system Auto Start/Stop.
 - 3. Temperature-sensing controls shall sense return air temperature.
 - 4. Indoor coil freeze protection.
 - 5. Wireless infrared remote control to enter set points and operating conditions.
 - 6. Automatic air sweep control to provide on or off activation of air sweep louvers.
 - 7. Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.
 - 8. Fan-only operation to provide room air circulation when no cooling is required.
 - 9. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.

10. Fan speed control shall be user-selectable: high, medium, low, or microprocessor controlled automatic operation during all operating modes.
11. Automatic heating-to-cooling changeover in heat pump mode. Control shall include dead band to prevent rapid mode cycling between heating and cooling.
12. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature when unit is in heat pump mode.

PART 3 -EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 1. Leak Test: After installation, fill water coils with water and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
 2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
 3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

3.2 STARTUP SERVICE

- A. Refer to Section 23 05 93 Testing, Adjusting, and Balancing for HVAC.

3.3 CLEANING

- A. Clean units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- B. After completing system installation and testing, adjusting, and balancing fan coil and air-distribution systems clean filter housings and install new filters.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION 23 81 26

SECTION 23 82 39.19 - ELECTRIC UNIT HEATERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electric Unit Heaters.
- B. Related Sections:
 - 1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers for placement by this section.
 - 2. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Product requirements for vibration isolators for placement by this section.

1.3 REFERENCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 90.1 - Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
 - 2. ASHRAE 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers.
- B. Underwriters Laboratories Inc.:
 - 1. Units to be UL Listed.

1.4 ACTION SUBMITTALS

- A. Provide line-by-line specification review annotated to certify compliance or deviation.
- B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Plans, elevations, sections, and details.
 - 2. Location and size of each field connection.
 - 3. Details of anchorages and attachments to structure and to supported equipment.

4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
5. Location and arrangement of integral controls.
6. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 1. Suspended ceiling components.
 2. Structural members to which unit heaters will be attached.
 3. Method of attaching hangers to building structure.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Air outlets and inlets.
 - b. Speakers.
 - c. Sprinklers.
 - d. Access panels.
 6. Lighting fixtures.
 7. Perimeter moldings for exposed or partially exposed cabinets.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of thermostats or other products not mounted on unit.
- B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept heaters and controls on site in factory packaging. Inspect for damage.

1.9 WARRANTY

- A. Furnish a five (5) year manufacturer warranty. Warranty shall begin from date of Certificate of Substantial Completion. Warranty start date from shipment or start-up will not be acceptable.

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATERS

- A. Manufacturers: Subject to compliance with scheduled capacities and specification, provide products by the following manufacturers.
 - 1. Reznor
 - 2. Markel
 - 3. Raywall
- B. Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, controls, and accessories complying with ARI 440:
 - 1. Discharge Louvers: Individually adjustable horizontal and vertical louvers to match cabinet finish.
 - 2. Control Voltage: 24-volt, 60 hertz
 - 3. Wall mounted adjustable thermostat.
 - 4. Location: Suspended overhead.
 - 5. Comply with UL 2021.
- C. Cabinet: 18-gauge steel with baked enamel finish, easily removed and secured access panels, insulated or double panel construction.
- D. Supply Fan: Propeller type with direct drive, dynamically balanced and mounted with rubber vibration insulators.
- E. Heat Exchanger: High mass, all steel tubular finned type, copper brazed elements.
- F. Controls: Wall mounted Thermostat with fan switch.
- G. Motor: Totally enclosed industrial rated. Motor on units to 20KW shall utilize sealed bearings. Motor on units larger than 20KW shall be 2-speed, permanent capacitor-type, continuous duty.
- H. Wiring:
 - 1. Sub-divided circuits with individual fuse protection
 - 2. Internal 24V control transformer.

3. Heavy duty magnetic contactors.
4. Thermal cutouts on control circuit with automatic reset.
5. Low voltage thermostatic kit with fan switch.
6. Factory wired disconnect switch.
7. Performance: Provide equipment as scheduled on Drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cabinet unit heaters to comply with NFPA 90A.
- B. Install unit heaters level and plumb.
- C. Suspend cabinet unit heaters from structure with elastomeric hangers. Refer to Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- E. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

- A. Comply with safety requirements in UL 1995.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

- B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature set points.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION 23 82 39.19

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUBSTITUTIONS OF PRODUCTS

- A. The products described in the Proposal Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. The materials and equipment named in, and the procedures covered by these specifications have been selected as a standard because of quality, particular suitability or record of satisfactory performance. It is not intended to preclude the use of equal or better materials or equipment provided that same meets the requirements of the particular project and is approved in an Addendum as a substitution prior to the submission of proposals.
- B. No substitution will be considered prior to receipt of proposals unless written request for approval has been received by the Architect and Engineer at a minimum of seven (7) business days prior to the date for receipt of proposals. Each such request shall include a specification line by line review annotated to certify compliance, the name of the manufacturer and model, material or equipment for which it is to be substituted and a complete description of the proposed substitute including dimensional drawings, cutsheets, performance and test data and any other information necessary for an evaluation. The Engineers decision of approval or disapproval of a proposed substitution shall be final.
- C. If the Engineer approves any proposed substitution prior to receipt of proposals, such approval will be set forth in an Addendum. Offerors shall not rely upon approvals made in any other manner.
- D. The Engineer and Owner reserve the right to disapprove the use of any manufacturer who in their judgment is unsuitable for use on the Project and that decision will be final.
- E. Availability of specified items:
 - 1. Verify prior to submittal of Proposal that all specified items will be available in time for installation during orderly and timely progress of the work.
 - 2. In the event specified items will not be so available, notify the Architect / Engineer prior to receipt of Proposals. Submit Request for Substitutions in accordance with this section.
 - 3. The request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or coordinate activities properly.

4. Costs of delays because of non-availability of specified items, when such delays could have been avoided by the Contractor, will be back-charged as necessary and shall not be borne by the Owner.
- F. A request constitutes a representation that Offeror:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 2. Will provide same warranty for Substitution as for specified product, except when inability to provide specified Warranty is reason for request for substitution as described above.
 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 5. Will reimburse the Owner and pay for all costs, including Architect/Engineer's redesign and evaluation costs resulting from the use of the proposed substitution, or for review or redesign services associated with re-approval by authorities having jurisdiction.
- G. **No substitutions will be considered after the Award of Contract.**

1.3 SUMMARY

- A. Provide all work for electrical systems required in the project to be properly installed, tested and performing their intended function.

1.4 QUALITY ASSURANCE

- A. Perform all work in accordance with the latest edition of the national electrical code, and local codes.
- B. All electrical materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new and unused and of United States Domestic manufacture unless approved otherwise by engineer or owner.
- D. Eliminate any abnormal sources of noise that are considered by the architect not to be an inherent part of the electrical systems as designed.

1.5 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the electrical system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the electrical system components.

- C. Make all electrical connections to all equipment furnished by this division and any other division.
- D. Make all electrical connections from all 120 volt and greater dampers and switches to associated exhaust fan(s) furnished by any other division.

1.6 DRAWINGS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Determine exact locations by review of equipment manufacturer's data, by job site measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. The size of the electrical equipment indicated on the Drawings may be based on the dimensions of a particular manufacturer. While other listed manufacturers will be acceptable, it is the responsibility of the Contractor to determine if the equipment that Contractor proposes to furnish will fit in the space. The drawings are not intended to show exact locations of conduit and wire, or to indicate all wire terminators, connectors, conduit fittings, boxes or supports, but rather to indicate distribution, circuitry, and control.
- B. The Electrical Drawings are necessarily diagrammatic in character and cannot show every connection in detail or conduit in its exact location. These details are subject to the requirements of ordinances and also structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Work shall be installed to avoid crippling of structural members. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
- C. When the mechanical and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts, physically arrange the systems to fit in the space available at the elevations intended with the proper grades for the functioning of the system involved. Exposed conduit is generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets and their location details. Work shall be concealed in all finished areas.

1.7 SUBMITTALS

- A. Specification Review:
 - 1. Include a paragraph-by-paragraph written specification review for each product listed requiring a submittal. Denote any proposed deviations from specifications.

1.8 EXISTING CONDITIONS

- A. Do all work required to maintain electrical services to the Owner occupied portions of the building during construction.
- B. No connection to existing services or utilities shall be made without Owner's knowledge and permission. All such connections shall be planned and scheduled to minimize the length of service interruption required. Request for shutdown shall be made to Owner at least two (2) weeks in advance and shall be accompanied by detailed written schedule of

activities during shutdown and list of materials required for connection and renewal of service. It shall be understood that all such service interruptions shall be made at the Owner's convenience, not the Contractor's. No increase in contract amount will be allowed for reasons of premium time, inefficiency of operations or other considerations not calculated in original bid.

- C. All items removed shall be stored on-site. Schedule a review of the items with the Owner. Remove from site all items the Owner does not choose to keep. Deliver Owner designated items to Owner's storage facility.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

PART 2 - PRODUCTS

- A. Provide allowance in bid for twenty-five 20A/1p circuits of 100 feet in length from source for miscellaneous needs during the course of construction. Include one duplex receptacle per circuit, all associated labor and all necessary accessories (conductor, conduit, supports, etc.) required for proper installation.
- B. Provide allowance in bid for twenty-five light switching circuit drops of twenty feet in length for miscellaneous needs during construction. Include one 277V light switch per circuit, all associated labor and all necessary accessories (conductor, conduit, supports, etc.) required for proper installation.
- C. Provide allowance in bid for ten additional exit signs for miscellaneous needs during construction. Include circuiting, all associated labor and all necessary accessories required for proper installation.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Provide temporary wiring and connections to maintain existing systems in service during construction.
- C. When performing work on energized equipment or circuits, use personnel experienced and trained in similar operations.
- D. Remove, relocate, and extend existing installations to accommodate new construction.

- E. Repair adjacent construction and finishes damaged during demolition and extension work.

3.2 OWNER INSTRUCTION

- A. Provide on-site Owner training for all new equipment.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide a complete system of building wire and cable to all electrical loads.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Provide stranded conductors for all wiring.
 - 2. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 3. Conductor not smaller than 16 AWG for control circuits.
 - 4. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet
 - 5. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
 - 6. Copper.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only Type THHN/THWN insulation, in raceway.
- C. Branch Circuit Conductors: No branch circuit conductors are allowed in any slab or under slab on grade unless specifically indicated on drawings.

1.4 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. Diamond Wire & Cable Co.
 - 2. Southwire
 - 3. General Cable Co.
 - 4. IUSA Wire
 - 5. Encore
- B. Product Description: Single conductor insulated wire.

- C. Conductor: Copper.
- D. Insulation: NFPA 70; Type THHN/THWN insulation for feeders and branch circuits.

2.2 TYPE AC CABLE

- A. Manufacturers:
 - 1. AFC
 - 2. Southwire
- B. Product Description: A fabricated assembly of insulated conductors in a flexible metallic enclosure.
- C. Comply with NEC 320.
- D. Support, provide separate support to structure for all Type AC cable, spacing not exceeding three (3) feet and at each junction box.
- E. Provide an insulated green grounding conductor in all Type AC cable.
- F. Acceptable Use: Install, at Contractor's option, only for service to light fixtures above accessible ceilings, limit length to six (6) feet whips from accessible junction box to light fixtures.
- G. Provide insulated throat fittings at all terminations of Type AC cable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.2 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques - Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - a. MDF/IDF room branch circuits: All branch circuits shall be dedicated and unspliced. Provide dedicated branch circuit 20 or 30 amperes, #10 and or #12 wire, unspliced from wiring device all the way back to the overcurrent device. Do not share ground with any other circuit.
 - b. Computer branch circuits: All branch circuits shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral with any other circuit.
 - c. Kitchen branch circuits: All branch circuits for 125 volt, single phase, 15 and 20 ampere receptacles shall be dedicated. Provide dedicated branch circuit 20 amperes, #10 and or #12 wire from wiring devices all the way back to the overcurrent device. Do not share neutral or ground with any other circuit.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.4 WIRE COLOR

A. COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

<u>System/Phase</u>	Wire Sizes #10 and Smaller: Use Continuous Color Coded Insulation (Note 01)				Wire Sizes #6 and Smaller: Use Continuous Color Coded Insulation (Note 02)	
	A	B	C	N	G	IG
120/208	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240	Black	Orange	Blue	White w/color stripe (Note 03)	Green	Green/Yellow Stripe

277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe
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Table Notes:

1. Wire size #8 and larger, black conductors with color marking tape at each termination and where accessible; colors as noted above.
 2. Wire sizes #4 and larger, black conductor with green marking tape at each termination and where accessible.
 3. Provide white (no stripe) insulation when 120/208V system is not present at this installation.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number and provide color coding at each junction box containing more than one neutral.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
 For 6 AWG and smaller: Green.
 For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.5 GROUPING OF CIRCUITS

- A. Limit the number of current carrying conductors per conduit to 6. Neutrals serving computer receptacle branch circuits shall be counted as current carrying. Grounds shall not be counted.
- B. Grouping of different voltages is not allowed.
- C. Provide metal box sizes per NEC Table 314.16 (A).
- D. Provide conduit per NEC Annex C.
- E. Neutrals serving branch circuits shall not be shared. Provide dedicated neutral per circuit.

3.6 POWER LIMITED CIRCUIT INSTALLATION

- A. Provide a complete system of raceway and covered junction boxes for all power limited circuits installed exposes in finished spaces and spaces without a ceiling.
- B. Provide raceway for all power limited circuit wiring within wall cavities and above sheet

- rock, plaster and other “hard” (non-lay-in) ceiling types of construction.
- C. Labeling: Provide label on all junction boxes.
1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the system wiring name.

END OF SECTION 23 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide a continuous low-impedance grounding system for the entire electrical wiring system.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. NFPA 70 - National Electrical Code.

1.4 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal underground water pipe.
 - 2. Metal building frame.
 - 3. Concrete-encased electrode.
 - 4. Ground ring.
 - 5. Rod electrode.
 - 6. Plate electrode.

1.5 SUBMITTALS

- A. Product Data: Submit data on grounding electrodes and connections.

1.6 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.7 GROUND RING PRE-INSTALLATION MEETINGS

- A. This paragraph shall apply to buildings when a ground ring is specified.

- B. Convene minimum one (1) week prior to commencing work of this section.
- C. Coordinate with concrete pour schedule for footings to insure rebar in concrete is available for bonding.

1.8 MADE ELECTRODE INSPECTION

- A. Convene prior to cover up of work of this section.
- B. Coordinate inspection of made electrode, exothermic welds and test well installation.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.
 - 3. Erico, Inc.
 - 4. O-Z Gedney Co.
 - 5. Thomas & Betts
 - 6. VFC
- B. Product Description:
 - 1. Material: Copper-clad steel
 - 2. Diameter: 3/4 inch
 - 3. Length: ten (10) feet

2.2 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: #2 AWG.
- C. Grounding Electrode Conductor: Copper conductor bare.
- D. Bonding Conductor: Copper conductor bare.

2.3 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.
 - 3. Erico, Inc.
 - 4. ILSCO Corporation
 - 5. O-Z Gedney Co.
 - 6. Thomas & Betts, Electrical

7. VFC

- B. UL Listed for grounding applications.
- C. Provide “ACORN” style ground clamp only for all driven ground rods unless noted to be exothermic connected in this specification. UL listed for connecting ground conductor to a driven ground rod.
- D. Description: Brass connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. Cadweld by Erico, Inc.
- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

2.5 GROUNDING BUSESSES

- A. When indicated, provide copper ground busses on walls in areas where special grounding needs will arise. Bus shall consist of copper bar as follows:
 - 1. Ground bar cross section of nominal four (4) inches by 1/4 inch; 24 inches length.
 - 2. Drill to accommodate NEMA Pattern D 2-hole compression lugs for ground wires to be installed. Leave remainder of bar for future drilling by owner.
 - 3. Copper compression lugs to connect conductors to the bar. Lugs shall be 2-hole type for double bolting to ground bar.
 - 4. Install all bolts for compression with top and bottom steel washers plus a Belleville spring washer between top washer and bolt head.
 - 5. Grounding electrode conductor(s) shall be fusion-welded on buss (and not lugged on).
 - 6. Mounting Free air, no enclosure required. Install Harger WBKT-1 brackets to mount bar to wall. Isolate copper bar from mounting brackets with Harger 4200-Series two (2) inch insulators.
 - 7. Fasten clear pexiglass cover on standoff bolts over ground bar. Engrave cover "GROUND BUS". Cover by Harger Lightning Protection, Inc., or approved equal.
 - 8. Ground bar assembly shall be Harger Lightning Protection, Inc. GBI Series (800-842-7437, www.harger.com), Erico, Inc. (800-248-9353) or approved equal.

2.6 DRIVEN ELECTRODE ACCESS WELL AND COVER

- A. Eight (12) inch diameter concrete pipe with belled end.
- B. 24 inches long or longer to reach ground and set flush in grade.
- C. Provide cast iron cover with "GROUND" embossed on top.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

- A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods compatible with existing electrical installations.

3.4 INSTALLATION

- A. Install in accordance with NEC Article 250. Properly bond the system neutral to the system grounding electrode conductor at the main service entrance equipment. All other neutral busses, bars, etc. on the service voltage system shall be isolated from ground. This system shall be the solid grounded type.
- B. Bond all ground electrodes together to form the grounding electrode system including metal underground water pipe, metal frame of the building or structure, concrete encased electrodes, ground ring, rod and pipe electrodes and plate electrodes.
- C. Install grounding and bonding conductors concealed from view.
- D. Install grounding electrode conductor and connect to reinforcing steel in foundation footing.
- E. Install a green equipment grounding conductor in all feeders and branch circuits, minimum size per NEC Table 250.122.
- F. Transformers: Ground as a separately derived source.
 - 1. Where transformer secondary includes a neutral, the neutral shall be bonded to the equipment enclosure and connected to the system ground conductor.

2. Size bonding jumper per NEC Table 250.66.
 3. Grounding conductor shall be in raceway and shall be bonded to nearest available point of interior metal water piping system.
- G. Bond together reinforcing steel and metal accessories in pool and fountain structures.
- H. Concrete-Encased Electrode (NEC 250-52):
1. Concrete-encased electrode is also known as the "Ufer ground". Concrete footings or foundation that are in direct contact with the earth and located at the building periphery shall be made available for use as electrodes. Designated footings shall be used for grounding purposes. Unless otherwise noted on drawings, designated footings are the perimeter building corners plus perimeter footings approximately on 100 feet centers between corners.
- I. Made Electrode:
1. Triple Ground Rod: Provide a building ground rod and bond it to the electrode system. The building ground rod shall consist of three ground rods, arranged in an equilateral triangular pattern located at least five (5) feet outside an exterior building wall or as otherwise directed. Space 15 feet apart and drive into the earth to a point two (2) feet below finished grade to top of rods. Grounding electrode conductor shall form a continuous loop around rods, and conductor shall be properly bonded to each rod by a fusion weld similar to "Cadweld".
 2. Extend grounding electrode conductor from this ground rod(s) to the grounded service conductor (neutral) in the building main switchboard at an accessible point on the ground bus per NEC 250-24.
 3. Install grounding electrode conductor of 3/0 Copper.
- J. Main Bonding Jumper: Shall be sized in accordance with Section 250-66, if not indicated on the drawings, and installed within the same enclosure as the point of bonding of the system neutral service entrance.
- K. Grounding Busses:
1. Provide a copper bus bar where indicated on Drawings. Provide grounding electrode conductor and connection to the grounding electrode system. AWG No. 2 minimum.
 2. Provide in each IDF and MDF room.
 3. Provide at each CATV / MATV head-end mounting board.
 4. Provide at each building communications rack.
 5. Provide at each sound reinforcement equipment rack.
- L. Water Pipe Electrode: A ten (10) foot minimum length of electrically continuous underground metal water pipe. Bond around insulating joints or sections, insulating pipe, and water meters to make pipe electrically continuous.
- M. Metal Building Frame NEC 250-52.
1. The structural steel or other metal frame of the building. Effectively ground the steel structural columns to the ground ring electrode.
 2. Cadweld AWG #2 bare copper cable to base of steel column. Route bonding jumper down through column blockout in building floor slab, excavate under grade beam, and extend out to the ground ring. Cadweld jumper (also called "stinger") or install Burndy Hyground™ Type YGHP-C hydraulic compression

- connector onto ground ring. Install a ground rod at each point where a stinger from a building steel column lands on the ground ring.
- N. Ground Ring Electrode (NEC 250-52):
1. Provide a tinned, bare copper conductor, size AWG #2 or larger, ground loop in direct contact with the earth. Install around and below the entire periphery of the building at least 36 inches underground. The ring conductor shall be in direct contact with the earth and below any concrete mat or seal slab that may be part of the building structural foundation. Bond this ground ring to all other electrodes and to the grounded service conductor (neutral) in the building main switchboard at a point on the supply side of each service disconnect.
- O. Fuel Gas Piping:
1. Each above ground portion of a gas piping system upstream from the equipment shutoff valve shall be made electrical continuous and bonded to the building grounding electrode system, as required in NFPA 54, National Fuel Gas Code.
 2. Gas piping shall not be used as a grounding electrode.
- P. Engine Generator Neutral:
1. Ground the generator neutral as a separately derived system per NEC 250-20(d).
 2. Sign: Provide a sign at the service entrance equipment indicating type and location of on-site generator.
- Q. Outdoor Lighting Poles:
1. All metallic outdoor poles and luminaries on metallic or non-metallic lighting poles shall be grounded by bonding in an approved manner to the circuit grounding conductor. In addition to this, bond pole to a #8 bare copper wire which shall also be bonded to a ground rod. Install the ground rod adjacent to the pole base with the top driven at least two (2) feet below grade.

3.5 OTHER GROUNDING SYSTEMS:

- A. General Check the drawings for special grounding system or grounding requirements.
- B. Telephone and data equipment grounding connections:
1. Bond each telephone and data equipment ground (buss type or grounding conductor type) at each telephone terminal board and data rack back to the service entrance grounding electrode system with a bare #6awg ground wire.
- C. Other Buildings Served From Common Service:
1. The main building service is the source for electric service to several out buildings on site.
 2. Isolate neutral bus from ground at each out-building main panel.
 3. Provide an equipment grounding conductor in feeder to each out-building main panel.
 4. Provide a local building ground rod at each out-building. Bond at least one building column footing to the ground rod.
 5. Bond grounding conductor of building main feeder to grounding electrode system established at the particular building.

3.6 EQUIPMENT GROUNDING SYSTEM

- A. General: Make a firm bond between all enclosures, equipment and metallic raceway system. Grounding conductors shall be continuous from origin to termination and properly bonded with lugs at both ends. The metallic raceway systems shall be made up properly to form a grounding path that has an impedance back to the main system ground that is as low as can be practically obtained.
- B. Over 250 Volts: Provide locknuts and/or listed fittings per NEC 250-97 for bonding of metal raceways in all circuits of over 250 Volts to ground. In case of oversized, concentric or eccentric knockouts, comply with NEC 250-92(B). The use of snap-in, wedge-type, or pivot-type connectors is prohibited.

3.7 FIELD QUALITY CONTROL

- A. Grounding Tests:
 - 1. Test the electrical system after installation is complete. Inspect and test for stray currents, unintended ground shorts, and proper physical condition of grounding system. Correct any deficiencies and re-test to verify satisfactory installation.
 - 2. Provide written test report to document all findings, test values, work done and certification of grounding system.
 - 3. Use true-RMS meters for all voltage and current measurements.
 - 4. Test telecommunications grounding riser to verify continuity.
 - 5. Check all isolated ground receptacles for correct polarity.
 - 6. Test all sub panels of separately derives systems to verify subpanel neutral is isolated from ground.
 - 7. Test theater isolated power system for the sound reinforcement system to verify isolation of ground system from other building systems.
 - 8. Verify continuity and isolation of audio system ground bus and grounding riser.
 - 9. Perform ground resistance and continuity testing in accordance with IEEE 142.
 - 10. When improper grounding is found on receptacle, check receptacles in entire project and correct. Perform retest.

3.8 TEST WELLS

- A. Install test well for designated outdoor driven ground rods. Set tops of well flush with finished grade. Provide mechanical connector for ground rod inside test well so that rod can be disconnected from ground ring or other grounding electrode system for testing.
 - 1. Designated Ground Rods:
 - a. One (1) at triple ground rod for High School Main Switchboard Electrical Room.
 - b. One (1) at each generator.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.

1.3 REFERENCES

- A. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL - Fire Resistance Directory.

1.4 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to Building Code and UL for fire resistance ratings and surface burning characteristics.

1.6 SUBMITTALS

- A. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with the Building Code.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company
 - 3. O-Z Gedney Co.
 - 4. Appleton
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

- A. Sleeves for raceway Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for raceway Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for raceway Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL Listed.
- D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 SPRING STEEL CLIPS

- A. Product Description: Mounting clamp, and screw.

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:

1. Thunderline Link-Seal, Inc.
 2. NMP Corporation
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

- A. Manufacturers:
1. Dow Corning Corp.
 2. Fire Trak Corp.
 3. Hilti Corp.
 4. International Protective Coating Corp.
 5. 3M fire Protection Products .
 6. Specified Technology, Inc.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 2. Foam Firestopping Compounds: Multiple component foam compound.
 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 7. Firestop Pillows: Formed mineral fiber pillows.

2.7 FIRESTOPPING ACCESSORIES

- A. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- B. General:
1. Furnish UL Listed products.
 2. Select products with rating not less than rating of wall or floor being penetrated.
- C. Non-Rated Surfaces:
1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.2 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors or preset inserts as required.
 - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners or welded fasteners as required.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors as required.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts or hollow wall fasteners as required.
 - 5. Solid Masonry Walls: Provide expansion anchors or preset inserts as required.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.
- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over four (4) inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to suspended ceiling support system, pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards one (1) inch off wall.
 - 4. Support vertical conduit at every floor.

3.3 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Place intumescent coating in sufficient coats to achieve rating required.
- F. Remove dam material after firestopping material has cured.
- G. Fire Rated Surface:
 - 1. Seal opening at all rated floors and walls as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL Listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, bus, or conduit, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- H. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated floors and walls as follows:
 - a. Install sleeve through opening and extending beyond minimum of one (1) inch on both sides of building element.
 - b. Size sleeve allowing minimum of one (1) inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Provide mechanical sleeve seals.
- B. Interior conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.

- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors and walls one (1) inch above finished floor level. Caulk sleeves.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

- A. Section includes conduit and tubing, wireways, outlet boxes, pull and junction boxes, and handholes.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Wet and Damp Locations: Provide rigid steel conduit. Provide cast metal junction and pull boxes. Provide flush mounting outlet box in finished areas.
- C. Concealed Dry Locations: Provide rigid steel intermediate metal conduit on electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

- D. Exposed Dry Locations: Provide rigid steel conduit, intermediate metal conduit or electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- E. In Slab or Under Slab on Grade: No branch circuit raceway is allowed in any slab or under slab on grade unless specifically indicated on drawings.

1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

1.6 COORDINATION

- A. Coordinate installation of outlet boxes and raceway for equipment connected under other Divisions.
- B. Coordinate installation of conduit for control wiring in mechanical rooms and in inaccessible locations such as walls and hard ceilings.
- C. Coordinate installation of conduit for all other low-voltage systems in inaccessible locations and all other locations required by drawings or specifications for those systems.
- D. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes. Refer to Architectural elevations and equipment specifications and coordinate device locations prior to electrical rough-in.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products
 - 2. Hubbell Wiring Devices
 - 3. Thomas & Betts Corp
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Multi Cell
 - 7. O-Z Gedney
 - 8. Raco.
 - 9. or approved equal.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit

- E. Electrical Metal Tubing (EMT): All EMT fittings shall be steel not die-cast metal. All conduit stub-ups above ceiling for low voltage and data to be provided with insulating bushing.
- F. Flexible Metal Conduit (Flex): Conduit fittings shall be steel. Provide plastic anti-short bushing for all flex fittings. Comply with NEC 348.
- G. Liquidtight Flexible Metal Conduit: Shall be same as flexible metal conduit specified above except Article 350 in NEC.
- H. PVC-Coated Rigid Steel Conduit: Galvanized rigid steel with additional external coating for 40 mil polyvinyl chloride jacket (PVC). Conforming to UL Standard 6. ANSI C80.1 and NEMA Standard No. RN.1.
 - 1. Manufacturer:
 - a. Ocal Inc.
 - b. Perma Cote Industries
 - c. Rob-Roy Industries
 - d. or Approved equal.
- I. PVC-Rigid Nonmetallic Conduit: PVC and fittings that are listed per the UL Standards. Comply with NEMA Standard TC-2.
- J. Nonmetallic Multi Duct: Provide nonmetallic multi duct that is UL Listed.
 - 1. Type: four (4) inches schedule 40 PVC outer duct, four 1.25 inch ducts of ribbed polyethylene. Duct shall have six (6) inch deep end bell on one end, spigot on the other end.
 - 2. Multi Duct shall have gaskets to seal the inside and outside walls of the inner duct.

2.2 ENCLOSURES

- A. Pull Boxes, Junction Boxes, Cabinets, and Wireways: Provide pull boxes, junction boxes, wireways, and cabinets wherever necessary for proper installation of various electrical systems according to the National Electrical Code and where indicated on the Drawings.
- B. Minimum Size: That size shown on the drawings, as required for the specific function, or as required by the National Electrical Code, whichever is larger.
- C. Construction:
 - 1. Indoors in Dry Areas and Not Buried in Slab: Code gage steel - NEMA 1 construction - sides formed and welded, screw covers unless indicated hinged cover or door on drawings. Hinged doors shall be similar to panelboard doors with the same type locking device. Knockouts shall be factory made or formed O-Z Gedney Type PB or approved equal.
 - 2. Outdoors or Indoors in Wet Areas and Not Buried in Slab: Same as specified above for indoor except provide NEMA 3R (designated by 3R or RT) unless indicated or specified to be NEMA 4 (designated by 4 or WP) or other type rating.
 - 3. Indoors Buried in Slab: Watertight, galvanized cast iron in floors on or below grade, otherwise concrete tight stamped steel.
 - 4. Outdoors Buried in Earth: Watertight, Polymer concrete similar to Hubbell Power System, Inc. "Quazite" or precast concrete type manufactured by Brooks Product, Inc brand for Oldcastle Precast, Inc. Precast box shall have appropriate structural rating for intended use. Install on a level poured concrete base to

provide a solid bearing surface. Provide a bolted cast iron traffic cover with foundry-cast marking "Electrical", "Communications" or "Telephone" as applies. Top of enclosure shall be one (1) inch above finished grade in earth. Top of enclosure shall be flush with finished pavement.

2.3 WIREWAY

- A. Manufacturers: Same as Metal Conduit.
- B. Product Description: General purpose.
- C. Size: As determined by Contractor in accordance with NEC 376.
- D. Cover: Screw cover.
- E. Connector: Slip-in.
- F. Fittings: Lay-in type.
- G. Finish: Rust inhibiting primer coating with gray enamel finish.

2.4 OUTLET BOXES

- A. Manufacturers: Same as Metal Conduit.
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- C. Cast Boxes: NEMA FB 1, Type FD, cast fer alloy. Furnish gasketed cover by box manufacturer.
- D. Wall Plates: As specified in Section 26 27 26.

2.5 FLOOR BOXES

- A. UL listed for wet application, watertight cast-iron.
- B. NEMA OS-1, sheet steel outlet boxes, device boxes, covers, and box supports.
 - 1. Floor: Fully adjustable before and after pour.
 - 2. UL Listed for wet application when installed into concrete, stone, tile or floor without carpet cover. Provide carpet flange where installed in carpet.
 - 3. Provide watertight, cast iron on floors at or below grade, and provide concrete tight stamped steel on all upper floors.
 - 4. Multi Gang Floor Box: Fully adjustable watertight cast iron gang floor boxes where shown on Drawings. Provide with removable partition and provide conduit openings in boxes as required. Install power circuits in separate raceway from data, telephone or other signal.
- C. Manufacturers:
 - 1. Appleton
 - 2. Carlon
 - 3. Crouse-Hinds

4. Hubbell
5. Thomas & Betts / Steel City
6. Walker

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION - RACEWAY

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 25 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.
- E. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- F. Arrange raceway supports to prevent misalignment during wiring installation.
- G. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- H. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29.
- I. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports

- J. Do not attach raceway to ceiling support wires or other piping systems.
- K. Construct wireway supports from steel channel specified in Section 26 25 29.
- L. Route exposed raceway parallel and perpendicular to walls.
- M. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- N. Maximum Size Conduit in Slab Above Grade: 3/4 inch.
- O. Maintain clearance between raceway and piping for maintenance purposes.
- P. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees Fahrenheit.
- Q. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- R. Bring conduit to shoulder of fittings; fasten securely.
- S. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- T. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes. DO NOT route conduit through the top of any outdoor disconnects, panels, etc. conduits must be routed through side or bottom only.
- U. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than two (2) inch size.
- V. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- W. Install fittings to accommodate expansion and deflection where raceway crosses expansion joints.
- X. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- Y. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- Z. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- AA. Close ends and unused openings in wireway.
- BB. Provide tracer wire on all underground raceway outside building slab on grade.

3.4 RACEWAY TYPES

- A. The following raceway types are to be used in the following locations:
 - 1. Under Slab on Grade: Schedule 40 PVC.

2. Outdoor Locations, Above Grade: Rigid galvanized steel.
3. Wet and Damp Locations: Rigid galvanized steel.
4. Exposed or Concealed Dry Locations, Indoors: EMT, IMC, or rigid galvanized steel.
5. Underground:
 - a. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 208 volts or greater shall be encased in red concrete two (2) inches thick on all sides. Encasement not required under building slabs, parking lots or other paved surfaces. Red dye may not be applied to the top of the concrete.
 - b. All underground electrical wire in schedule 40 PVC or rigid galvanized steel, 120 volts or less shall have red warning tape 6" above raceway.
6. Transformers and Motors: 24 inch flexible metal conduit to equipment.
7. Kitchens and outdoor motor and transformer connections: Liquidtight flexible metal conduit for all exposed raceway.
8. Cooling Towers: PVC coated rigid galvanized steel within 50 feet of tower.

3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings and as approved by the Architect.
- B. Adjust box location up to ten (10) feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 126 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- F. Do not fasten boxes to ceiling support wires or other piping systems.
- G. Support boxes independently of conduit. Provide rigid support to structure for all junction boxes. Mount junction boxes within 18" of finished ceilings to facilitate future access. Locate junction boxes to allow ready access to junction box covers without removing any equipment.
- H. All outdoor boxes shall be UL listed for wet location service.
- I. Provide rigid support to structure for all junction boxes.
- J. Provide rigid support to structure for all conduit within 3 feet of each junction box and a maximum spacing of 10 feet.
- K. Install junction boxes above ceilings in readily accessible with no obstructions, locate within 18 inches of finished ceiling to facilitate easy access.
- L. For all flexible whips to light fixtures provide wire support at mid-length of whip to structure above with UL listed conduit support clip.

- M. Provide outlet boxes to meet depth requirement of Architectural walls. Refer to Architectural Spec Section 09250 and 10611 for wall partitions.

3.6 ADJUSTING

- A. Install knockout closures in unused openings in boxes.

3.7 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

3.8 INSTALLATION - FLOOR BOXES

- A. Use cast floor boxes for installation in slab on grade.
- B. Set floor boxes level.
- C. Install boxes and fittings to preserve fire resistant rating of slabs and other elements, using materials and methods specified in Section 26 05 29.

3.9 ADJUSTING

- A. Adjust floor box flush with finish material.

3.10 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.

3.11 ABOVE CEILING JUNCTION BOXES

- A. Labeling: Provide label on all above ceiling junction boxes.
 - 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box. Junction boxes used for emergency power circuits to be painted red.

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Underground Warning Tape.
 - 3. Lockout Devices.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical identification, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and standards: Comply with the following:
 - 1. National Electrical Code, NFPA No. 70.
 - 2. NEMA standards applicable to the product provided.
 - 3. UL standards applicable to the product provided.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
 - 1. Panduit Corp.
 - 2. American Labelmark Co.
 - 3. Markal Corp.
 - 4. Calpico, Inc.
 - 5. Ideal Industries, Inc.

2.2 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- B. Emergency Power panels and Equipment: Laminated three-layer plastic with engraved white letters on **RED** background.
- C. Letter Size:

1. 1/4 inch high letters for identifying individual equipment and loads.
- D. Minimum nameplate thickness: 1/8 inch.
- E. Receptacles: All receptacles shall be labeled with panel name, circuit number, and number of receptacles on current circuit per school standards.

2.3 UNDERGROUND WARNING TAPE

- A. Description: four (4) inch wide plastic tape, colored red with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
1. Install nameplate parallel to equipment lines.
 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 4. Secure nameplate to equipment front using screws, rivets, or adhesive.
 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 6. Install nameplates for the following:
 - a. Switchboards
 - b. Panelboards
 - c. Transformers
 - d. Service Disconnects
 - 1) Enclosed Switches
 - e. Motor Control Centers
 - f. Stand-alone Motor Controllers
 - g. Generators
 - h. Contactors
- C. Underground Warning Tape Installation:
1. Install underground warning tape along length of each underground conduit, raceway, or cable six (6) to eight (8) inches below finished grade, directly above buried conduit, raceway, or cable. Where multiple lines installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
 2. Install line marker for underground wiring, both direct buried and in raceway.
- D. Printed Panelboard Directory:

1. Provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker for that panel, switchboard, or motor control center.
2. Panelboard directory shall include a legend indicating insulation color corresponding each phase and voltage in the building electrical system.
3. Copy in Owner's Manual.

3.3 ABOVE CEILING JUNCTION BOXES

- A. Labeling: Provide label on all above ceiling junction boxes.
 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box.

3.4 ARC FLASH WARNING LABEL

- A. Switchboards, panel boards and motor control centers requiring examination, adjustments, servicing or maintenance while energized shall be field marked to warn persons of arc flash hazards. Marking shall be located so as to be clearly visible to qualified persons before servicing or maintenance.

END OF SECTION 26 05 53

SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 26.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the owner will manage the commissioning process.

1.2 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.3 SUMMARY

- A. This Section includes requirements for commissioning the Facility electrical systems, related subsystems and related equipment. This Section supplements the general requirements specified in Section 01 91 00 General Commissioning Requirements.
- B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the OWNER's Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 and of Division 26, is required in cooperation with the OWNER and the Commissioning Agent.
- B. The Facility electrical systems commissioning will include the systems listed in Section 01 91 00 General Commissioning Requirements:

1.6 SUBMITTALS

- A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the OWNER prior to

forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 CONSTRUCTION INSPECTIONS

- A. Commissioning of Electrical systems will require inspection of individual elements of the electrical systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 and the Commissioning plan to schedule electrical systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the OWNER and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING

- A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The

Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF OWNER PERSONNEL

- A. Training of the OWNER operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00. The instruction shall be scheduled in coordination with the OWNER Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 26 Sections for additional Contractor training requirements.

END OF SECTION

SECTION 26 09 14 - ELECTRICAL CONTROLS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The general provisions of the Contract and the requirements of Section 26 05 00 apply to Work specified in this Section.

1.2 SUMMARY

- A. Provide complete and operational electrical control systems as outlined within this Section.
- B. Refrigerant detection and alarm system is provided by Division 23 Mechanical.
- C. Elevator Shutdown System(s): All heat detectors, supervisory addressable modules, and supervised fire alarm wiring shall be furnished and installed as part of building fire alarm system. Refer to section 28 31 00 for additional requirements of fire alarm system.

1.3 SUBMITTALS

- A. Provide submittals according to Section 26 05 00. Coordinate with section 28 31 00 Fire Alarm System Submittal for Items to be furnished and installed as part of the Fire Alarm System.
- B. Product Data:
 - 1. Component manufacturer's literature explaining all components of each system.
- C. Shop Drawings:
 - 1. Complete point to point interface and control wiring schematics.
 - 2. Show size and location of all fused elevator shutdown switches and panels. Identify all fuse types, quantity and ampacity.
- D. Closeout Submittal: Provide manuals as described in Section 26 05 00.

1.4 OWNER'S INSTRUCTION

- A. Provide a one hour period of instruction for each system to the Owner's designated personnel upon completion of system installation. Instruction shall include a functional training session on operation and system test procedures.
- B. Elevator Power Shutdown System: Schedule instruction after building fire alarm system becomes operational. Demonstrate that heat detector(s) is connected to the building fire alarm system and that fire alarm system output connects into shunt trip circuit of the elevator power shutdown switch(s).

1.5 EXTRA MATERIALS

- A. General: Provide extra material's for Owner's use. All parts shall be identical to installed components.
- B. Fuses:
 - 1. Full Set: A full set is (three phase) of each different ampacity fuse in an elevator shutdown panel and in each elevator shutdown switch.
 - 2. Provide two full sets of spare fuses for each elevator shutdown panel and switch. Fuses blown and replaced during construction and commissioning do not count as spares.
 - 3. Provide a metal cabinet in each elevator machine room for the spare fuses. Cabinet shall be furnished by the fuse manufacturer or approved equal.

PART 2 - PRODUCTS

2.1 REFRIGERATION MACHINERY ROOM EMERGENCY SYSTEM:

- A. General: Provide switches outside each exits from the central plant refrigeration machinery room as required by the Uniform Mechanical Code. Refer to Mechanical Drawings for sequence of operation for chiller machine room "purge" system.
- B. Emergency Purge Ventilation Fan Switch (EPS):
 - 1. Function: Comply with Uniform Mechanical Code 1107.5. Provide a break-glass switch arranged for ON-only control of fan(s) used for emergency purge ventilation system for refrigerant escape. EPS shall require manual resetting.
 - 2. Construction: Switch shall be designated for surface mounting with contact blocks rated 125 Volts ac, 10 amps continuous, and include a cast box, glass cover an permanently attached break glass hammer. Switch shall be Allen Bradley 800T-NX115, ASCO Cat No. 124302, Crouse-Hinds EFSC21095 Series, Square D Class 9001 Type K15 on FD box, or approved equal.
 - 3. Label: Switch shall be permanently labeled "Emergency Purge Switch".
 - 4. Location: Immediately adjacent to-within two feet-and outside of each refrigeration machinery room exit.
- C. Emergency Refrigeration Switch (ERS):
 - 1. Function: Comply with Uniform Mechanical Code 1108.4. Provide a break-glass switch arranged for OFF-only control of all electrically operated machinery in the refrigeration machinery room, except the exhaust ventilation system controlled by the EVS. Lighting fixtures shall not be affected by the ERS. Upon activation, the ERS shall immediately shutdown machinery. After shutdown, manual resetting shall be required to restore power to each chiller and motor affected. Loss of power from the Electric Utility, temporary or sustained blackout, shall not cause the ERS to operate.
 - 2. Construction: Switch shall be designated for surface mounting with OFF-only contact blocks rated 125 Volts ac, 10 amps continuous, and include a cast box, glass cover and permanently attach break glass hammer. Switch shall be Allen Bradley 800T-NX115, ASCO Cat No. 124302, Crouse-Hinds EFSC21095 Series, Square D Class 9001 Type K15 on FD box, or approved equal.
 - 3. Color: Switch shall be painted bright RED.
 - 4. Label: Switch shall be permanently labeled "Emergency Refrigeration Switch".
 - 5. Location: Immediately adjacent to-within two feet-and outside of each refrigeration machinery room exit.

2.2 ELEVATOR POWER SUPPLY AUTOMATIC DISCONNECT SYSTEM:

- A. General: Provide an elevator power automatic disconnect system in each elevator equipment room as required by ASME A17.1 Elevator Safety Code Rule 102.2 (c). Heat detectors and other parts of automatic disconnect means shall be separate from, and independent of, the building fire alarm system. Disconnecting means shall not be self-resetting.
- B. State Regulation: Make arrangements for all inspections required by State of Texas. Correct any deficiencies in elevator electrical power supply automatic disconnect system that may be noted by State elevator inspector. Repeat until successful completion of all State of Texas Inspection Reports and Certificates of Compliance as required for ELEVATORS, ESCALATORS AND RELATED EQUIPMENT by the Texas Department of Licensing and Regulation.
- C. NFPA: Comply with National Fire Protection Association Standard 72-1999, National Fire Alarm Code, Sect. 3-9.4 (1996 NFPA 72 section 3-8.15).
- D. Disconnecting Means:
1. Single-Car Machine Room: Provide Bussmann Power Module Switch Cat. No. PS in NEMA 3R enclosure. Switch rating amps shall be next size larger than fuses. All fuses shall be Class J current-limiting fuses. Provide shunt trip, 120 Volt control power transformer, Bussmann Option R2 fire alarm interface relay and key test switch for elevator feeder. Entire assembly shall be UL-listed and have 200,000 RMS symmetrical ampere interrupting rating.
 2. Class J Fuse Sizing: 175% Full Load Amps per elevator motor.
 3. Enclosure: NEMA 3R.
 4. Label: Label shunt-trip fused switch "Elevator Automatic Disconnect".
 5. Install wiring to remote heat detectors. Bussmann Option A: Comply with NEC 620-91 (c). For each hydraulic elevator that has automatic recall, provide one Bussmann Option A with fused switch for that elevator shutdown. Option A is a normally-closed mechanical interlock. It prevents inadvertent recall of hydraulic elevator. Automatic recall for hydraulic elevator is typically a Division 14 item for battery pack and electric solenoid on the hydraulic valve at the elevator controller. Automatic recall is typically provided when the hydraulic elevator is not on standby generator power.
- E. Heat Detector:
1. Install an approved heat detector with replaceable heat element within two feet of each sprinkler head in each elevator equipment room, each elevator pit, and in each elevator hoistway. Connect all heat detectors to contactor shunt trip(s) described above. Heat detector shall cause shunt trip to open the contactor associated with each elevator fused switch.
 2. Heat detector shall have a lower temperature rating than the sprinkler head. Ex. 135°F-fixed temperature detector versus 165°F sprinkler.
 3. Heat detector shall also have higher sensitivity than sprinkler. Detector higher sensitivity is often characterized by lower response time index (RTI). Listed spacing of heat detector shall be 40 feet or greater (NFPA 72, sect. Appendix 3-8.15.1).
 4. Heat detector shall be combination rate-of-rise and fixed-temperature design as recommended in ASME Handbook to ANSI/ASME A17.1 Safety Code for Elevators and Escalators, explanation for Rule 102.2 (c)(3).

5. Install a heat detector at each sprinkler head in all following locations that have sprinklers:
 - a. Elevator machine rooms;
 - b. Elevator hoistway;
 - c. Elevator pit.
6. Heat detector shall be Notifier Model No. HD-621 or approved equal. Detector shall have Normally Open, dual output contacts. Both contacts shall be rated at least 3A @ 6-125 Vac and 1A @ 6-28 Vdc.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. All components shall be properly mounted and wired.

3.2 INTERFACE WITH INVOLVED EQUIPMENT:

- A. Each system shall have all necessary control circuitry, relays, and contacts to provide functions as specified, and shall be capable, if necessary of interfacing to voltages 12-120 AC/DC, N/O or N/C contacts, wet or dry contacts, and momentary or maintained signal required. Verify type of interface control required with manufacturer of associated equipment. Provide necessary control power system for any wet contacts that are required, including control transformers, rectifiers, wiring, circuit breakers, etc.

3.3 CONTROL POWER SUPPLY:

- A. Elevators: Provide 120 volt control power as required from the same 208/120 volt circuit breaker panelboard serving the various 120V branch circuits in the elevator machine room.

3.4 ELEVATOR DISCONNECT:

- A. National Electrical Code:

NEC 620-51 (b): Provide a disconnecting means for main power supply conductors to each elevator car. The elevator disconnecting means shall be part of the automatic shutdown system to open the power supply prior to application of sprinkler water.

NEC 620-51: The disconnecting means for the main power supply conductors to each elevator car shall not disconnect the branch circuits required by NEC 620-22, 620-23 and 620-24.

3.5 TESTING:

- A. Test each system in the presence of the Owner, Architect, and Engineer to verify proper operation of elevator power supply automatic disconnect systems.
- B. State Elevator Inspector: Include State Elevator Inspector in test witnessing. At the sole option of the State Elevator Inspector, provide separate testing as that person may require. Provide all testing of disconnect systems as required by State Elevator Inspector to allow all Inspection Reports and Certificates of Compliance to be completed.

LEAF Engineers
PBK Project No. 230462
Pkg 2 – Issue for Permit

WFAC Black Box Addition
Alamo Colleges District
July 19, 2024

END OF SECTION 26 09 14

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes enclosed contactors for lighting and general purposes. Provide complete systems using contactors, relays, photocells, time clocks, or digital time switches, where required, all properly mounted in enclosures.

1.3 SUBMITTALS

- A. Product Data: Submit dimensions, size, voltage ratings and current ratings.
- B. Short circuit current rating (SCCR) of equipment.
- C. U.L. Label.
- D. Electrical characteristics of equipment.
- E. Enclosure metal gauge and finish.

1.4 CLOSEOUT SUBMITTALS

- A. Provide manuals as described in Section 26 05 00.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE CONTACTORS

- A. General: Provide contactors and relays with ratings as indicated or as required to operate the installed load at the applied voltage using the applied contact voltage. Contactor shall be rated for making and breaking motor or other inductive loads.
- B. Manufacturers:
 - 1. ASCO
 - 2. Square D
 - 3. GE
- C. Enclosure: Provide a NEMA 1 enclosure for all contactors located indoors. Provide NEMA 4X for those located outdoors and in wet areas.
- D. Lighting Contactors:

1. Mechanically held, electrically operated.
 2. ASCO 918 or approved equal.
 3. Provide ASCO Accessory 47 for two-wire control of contactor. Provide time switch and photocell to control contactor.
 4. Some lighting contactors may be designated for control by Division 23 Building Automation System (BAS). Provide contactor and ASCO solid-state Accessory 47 for two-wire control of contactor. Division 23 shall provide all BAS control wiring. BAS provides all time-of-day ON/OFF scheduling.
 5. Three-phase Contactors: When lighting contactors are indicated to control an entire panel or sub-panel, provide ASCO 920 or approved equal. Include two-wire control relay ASCO Accessory 47.
 6. Parking Lot, Exterior Lighting and Sport Lighting Contactors: Provide 3-phase, 3-pole ASCO 920 contactors as indicated on Drawings. Include two-wire control relay ASCO Accessory 47. Also provide solid state control module and housing with Hand-off-Auto selector switch. All contactors that control any branch circuit that serves any lighting fixtures or entire panels that feed outdoor lighting shall be provided with the HOA control feature.
- E. SCCR: Contactor shall have short circuit current rating established by actual testing with specific overcurrent protection device. SCCR shall be UL-listed.

2.2 PHOTO-ELECTRIC CONTROLS:

- A. Description:
1. General: Photo-electric control shall switch load ON at dusk and OFF at dawn.
 2. Housing: Photocell shall be enclosed in a weatherproof, corrosion resistant housing. The housing shall have a 1/2 inch I.P.S. nipple with a locking washer.
 3. Element: Light sensing element shall be Cadmium-Sulfide cell hermetically sealed against moisture. Minimum time delay before change-of-state shall be 15 seconds. If the photo-electric control fails, the load shall switch ON (fail-safe ON).
 4. Adjustment: The housing shall have an adjustable slide shield to vary the ambient light reaching the CdS cell. The slide shield shall not override the control; that is, the ON/OFF function shall occur even when the shield is at either extreme of the adjustment range. Adjustment shall be made by hand without tools.

5. Temperature: The photocell shall be suitable for operation in an ambient temperature range of -30 degrees Fahrenheit to + 140 degrees Fahrenheit.
6. Voltage: The photocell shall be suitable for use at voltage equal to the load voltage (120, 208, 277).
7. Capacity: Photocell shall be SPST rated for a minimum of 1800 Volt-Amps resistive or inductive load.
8. Leads: Photocell shall have minimum six (6) inch wire leads with wet location insulation. Leads shall be color coded Red/Load, Black/Line and White/Neutral.
9. Listing: Photocell shall be listed by Underwriters Laboratories.

B. Manufacturer: Intermatic, Paragon, Precision, Tork.

2.3 TIME CLOCKS:

A. Manufacturer:

1. Grasslin
2. Intermatic
3. Paragon
4. Precision
5. Tork

B. General: Provide time clocks similar to Intermatic Series T 1900 or Tork B8000 Series. Provide wiring to photocells, contactors, relays or other control points as required.

C. Contacts: Rated for 20 amps minimum at 277 volts. Provide 1, 2, 3 or 4 pole, single or double throw, maintained or momentary contact, as required based on the time clock function and the number of branch circuits controlled. Contacts shall be horse power rated when motors are switched.

D. Dial: Provide 24-hour dial with 15 minute intervals minimum. Dial shall permit at least 48 ON/OFF cycles per day via 96 adjustable tabs. Dial shall include a skip-a-day wheel and two day-omitting pins. Provide extra trippers and day-omitting pins if required.

E. Special Dials: Provide special dial where indicated on drawings or in these specifications. Provide astronomic dial for time clock controlling outdoor lighting.

F. Timing Motor: Provide heavy duty synchronous timing motor, self-starting and permanently lubricated. Motor shall be permanent magnet type for high torque and operate through and ambient temperature range of - 30 degrees Fahrenheit to + 130 degrees Fahrenheit. Motor cover shall have a viewing window to check for rotation of gears. Motor voltage shall be 120, 208, 240 or 277 volts as required.

G. Reserve Power: Provide a spring driven reserve power drive to operate time clock for at least ten (10) hours after a power failure.

H. Manual Bypass:

1. Time clock shall include a manual ON/OFF bypass switch capable of overriding time schedule without disturbing trippers or timing sequence.
2. Time clock shall be installed with a pilot-light SPST toggle switch mounted in a separate, adjacent single-gang box. Switch shall be labelled "Bypass" and shall function to turn ON circuit(s) controlled by the time clock. Switch shall be flush or surface mounted to match time clock housing.

- I. Terminals: Time clock shall have a terminal block with screws for line, load, and grounding connections with up to AWG #8 wire. Provide a removable dead-front terminal cover within the time clock case. Timing motor shall have separate, unswitched terminals.
- J. Enclosure: Provide a NEMA 1 enclosure with hasp suitable for padlock and side-hinge door for all clocks located indoors. Enclosure shall have 1/2 inch and 3/4 inch knockouts in bottom and sides. Provide NEMA 4X for those located outdoors and in wet areas.
- K. Nametag: Provide a nametag for each time clock stating load controlled; see Section 26 05 53, Electrical Identification.
- L. Listing: All time clocks shall be listed by Underwriters Laboratories and C.S.A.
- M. Manuals: Provide three sets, each consisting of operating instructions and one-line diagrams.

2.4 DIGITAL TIME SWITCHES:

- A. Recessed in wall: Wattstopper TS-400 or approved equal.
 - 1. The digital time switch shall be programmable to turn lights off after a preset time.
 - 2. Time switch shall be a completely self-contained control system that replaces the standard toggle switch. It shall have a ground wire and ground strap for safety. Switching mechanism shall be a latching air gap relay.
 - 3. Zero Crossing Circuitry shall be used to increase the relay life, protect from the effects of inrush current, and increase the switch's longevity.
 - 4. Time switch shall be compatible with all electronic ballasts, motor loads, compact fluorescent and inductive loads. Triac and other harmonic generating devices shall not be allowed.
 - 5. Time switch shall operate at universal voltages of 100-300 VAC; 50/60 Hz.
 - 6. Time switch shall have no minimum load requirement and shall be capable of controlling 0 to 800 watt incandescent, fluorescent @ 100/120 VAC, 50/60 Hz; 0 to 1200 watts fluorescent @ 230/277 VAC, 50/60 Hz; 1/6 hp @ 125 VAC.
 - 7. Time scroll feature shall allow manual overriding of the preset time-out period. Selecting time scroll UP shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll DN (down) shall allow time-out period to scroll down to minimum.
 - 8. Time switch shall have the option for a one second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).
 - 9. Time switch shall have the option for a beep warning that shall sound every five seconds once the time switch countdown reaches one minute.
 - 10. Time switch shall have manual feature for timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.
 - 11. Time switch shall have an electroluminescent backlit Liquid Crystal Display that shows the timer's countdown.

12. Time switch shall fit behind a decorator style faceplate. The calibration switch for setting time-out, time scroll, one second light flash, and beep warning shall be concealed to prevent tampering of adjustments and hardware.
13. Time-out period shall be adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.
14. Time switch shall be capable of operating as an ON/OFF switch.
15. For ease of installation and cleaner wiring, the switch shall utilize terminal style wiring.
16. The time switch shall not protrude more than 1/8" from the wall and should blend in aesthetically.
17. For safety, the time switch shall have a 100% OFF override switch with no leakage current to the load.
18. For safety, in the event there is an open circuit in the AC line such as a ballast or lamp failure, the time switch shall automatically switch to OFF mode.
19. To ensure quality and reliability, time switch shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
20. Time switch shall have 5 year warranty and shall be UL and CUL listed.

2.5 OCCUPANCY SENSORS:

- A. Ceiling Sensors: Require power packs
 1. W-2000- Low voltage ultrasonic ceiling mounted with 2000 square foot coverage. Typical for large restroom.
DT-300- Low Voltage dual technology ceiling mounted with isolated contact. Typical for classrooms.
 2. WT-2250/2255- Typical corridor sensor- Low voltage ultrasonic ceiling mounted with 10' by 90' coverage pattern
- B. Wall Switch Sensors:
 1. PW-100 Line voltage PIR wall switch sensor for 1 circuit- Typical for small office or single person restroom.
PW-100-24 Low Voltage PIR wall switch sensor. Requires power pack
PW-200- Line voltage PIR wall switch sensor for 2 circuits,
UW-100- Line Voltage ultrasonic wall switch sensor for 1 circuit.
DW-100- Line voltage dual technology wall switch sensor for 1 circuit. Typical for large office or conference room.
DW-100-24- Low voltage dual technology wall switch sensor. Requires Power Pack
DW-200- Line voltage dual technology wall switch sensor for 2 circuits
 2. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
 3. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180° coverage capability.
 4. Wall switch products shall utilize Zero Crossing Circuitry which increases relay lifeprotects from the effects of inrush current, and increases sensor's longevity.
 5. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.
 6. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.

7. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.
- C. Power and Auxiliary Packs:
1. BZ-50- Standard power pack for use with low voltage sensors. 225ma
 2. BZ-150- Power pack for use with low voltage sensors when using a manual on function. 225ma
 3. S120/277- Slave relay pack. For controlling more than 1 circuit from a low voltage sensor. Standard BZ-50 can also be used.
- D. High Ceiling Applications
1. HB-350B*LENS Low Voltage PIR sensor
 2. L1 Lens- 20' x 60' coverage pattern when mounted at 40'
 3. L3 Lens- 40' diameter coverage pattern when mounted at 40'
 4. L4 Lens- 60' diameter coverage pattern when mounted at 60'
- E. Passive infrared sensors:
1. Passive infrared sensors shall utilize Pulse Count Processing and Detection Signature Processing to respond only to those signals caused by human motion.
 2. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).
 3. Passive infrared sensors shall have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
 4. Where specified, passive infrared ultrasonic and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.
- F. Dual technology sensors:
1. Dual technology sensors shall be wall mounted, corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas.
 2. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.
- G. Ultrasonic sensors:
1. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
 2. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within $\pm 0.005\%$ tolerance, 32 kHz within $\pm 0.002\%$ tolerance, or 40 kHz $\pm 0.002\%$ tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.
- H. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.
- I. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
- J. When specified, sensors shall utilize SmartSet™ technology for automatically adjustable time delay and sensitivity settings.

- K. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
- L. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
- M. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
- N. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.
- O. All sensors shall have UL rated, 94V-0 plastic enclosures.
- P. All occupancy sensors shall be set to maximum 30 minute time delay.
- Q. Provide minimum 5% spare sensors for owner stock of each type of occupancy sensor.

2.6 DAYLIGHT HARVESTING – Wattstopper LightSaver® LS-102 Daylighting Controller

- A. The light level controller shall be capable of detecting changes in lighting levels.
- B. The light level controller shall utilize an internal photocell that measures light in a 100 degree angle cutting the unwanted light from bright sources outside of this cone.
- C. The light level controller shall be capable of controlling any type of lighting through use of power packs. Light level controller shall operate from a 24 volts DC power supply; current draw is 22 milliamps.
- D. The LS-102 light level controller shall be capable of turning lighting on and off for a single zone and has a light sensors over 1 to 1400fc.
- E. The light level controller shall have an adjustable deadband feature with 25%, 50%, 75% or 100% in relation to the setpoints. This prevents lighting from cycling when lighting goes on and off and from minor changes due to cloud cover.
- F. The light level controller shall have an adjustable time delay range of 3, 10, 15 or 30 minutes. This will prevent cycling on partly cloudy days and is necessary with HID lighting.
- G. The LS-102 shall provide a connection for an optional low voltage, normally open momentary contact watt switch override.
- H. The LS-102 provides a “hold on while occupied” feature that prohibits high levels from turning OFF the controlled lights as long as the space remains occupied.

- J. The LS-101 has an ON Setpoint range from 1-850fc and when the daylight drops below that setpoint for 20 seconds the electric lights will be turned ON.
- K. The LS-102 has a microprocessor that allows the photosensor to respond with precision to deliver the desired intensity of electric lighting for the space.
- L. The light level controller has a LED status indicator making it easy to identify if the device has been forced on or off by an override switch or if the device is in test mode.
- M. The LS-102 has a threaded nipple that mounts on a ceiling tile and for more challenging applications such as a side wall or hard rock ceiling the nipple pops off and the LS-101 can be screwed down.
- N. Light level controller shall have standard 5 year warranty.

2.7 SPORTS LIGHTING CONTROL STATION

- A. General: Provide pushbuttons for manual override of programmable relays designated to control the power contactors for the outdoor sports lighting at each field. Arrange pushbuttons into a single enclosure for each field.
- B. Enclosure: Enclosure shall be NEMA 4X stainless steel or polycarbonate with gasketing for outdoor wet locations.
- C. Pushbutton: Similar to Square D Class 9001-Type B, Type BW245, NEMA 4, momentary contact, RED/ON and GREEN/OFF pushbuttons with collar guard.
- D. Wiring: From each pushbutton in the Sports Lighting Control Station, provide low voltage wiring to the programmable relay cabinet.
- E. Control: BAS schedules all power contactors for outdoor sports lighting via the programmable relay system. Each sports field shall have a programmable relay assigned to the contactors for the sports lighting of that field. BAS will program automatic schedules for the sports lighting as required. User shall be able to override automatic schedule from BAS with manual ON/OFF signals from the pushbutton Lighting Control Stations. Pushbutton signals relay cabinet, similar to a classroom light switch, and relay causes the lighting contactors to change state (OFF to ON, ON to OFF).
- F. Engraving: Provide engraved lamacore plate above each pushbutton describing the lighting it will control. Example: TENNIS COURTS; FOOTBALL-EAST POLES, FOOTBALL-WEST POLES, BASEBALL, SOFTBALL.
- G. Relays: For each pushbutton control, provide a relay in the local relay cabinet nearest the sports lighting contactors. Wire relay to the control circuits of the associated sports lighting contactors. Program BAS for both automatic scheduling of the sports lighting and to accept manual override from pushbutton Sports Lighting Control Stations.

PART 3 - EXECUTION

3.1 PHOTO-ELECTRIC CONTROL MOUNTING:

- A. Provide photo-electric control on roof of building. When more than one building is constructed on site, install photo control on each roof. Aim true North and locate in places where ambient night lighting will not cause interference. Wire down to respective contactors in each building.

3.2 TIME CLOCK PROGRAMMING:

- A. Install time clock and photocell for ON by photocell at dusk, OFF by time clock at midnight, then ON by time clock at 5:00 a.m. and OFF by photocell at dawn. Program time clock ON/OFF times to other time(s) when indicated on Drawings.

3.3 INSTALLATION

- A. Install enclosed contactors (as indicated on Drawings), in accordance with NECA "Standard of Installation".
- B. Install engraved nameplates. Refer to Section 26 05 53 for requirements.
- C. Install contactor and relays in Electrical / Mechanical Rooms unless otherwise noted.

END OF SECTION 26 09 23

SECTION 26 20 00 - ELECTRICAL DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Conditions of the Contract Documents and Division 1 - General Requirements as applicable, apply to this Section.

1.2 SUMMARY

- A. Provide all electrical distribution and motor control equipment and accessories required to distribute electrical power to all motors, outlets and systems requiring power.

1.3 QUALITY ASSURANCE

- A. New: Provide all new equipment.
- B. Single Manufacturer: All equipment of each type shall be the product of one manufacturer.
- C. UL: Equipment shall be UL listed. Service entrance equipment shall bear UL Service Entrance label.
- D. NEC: Equipment and installation shall comply with the National Electrical Code.
- E. Wet Locations: Equipment and enclosures installed outdoors and in wet locations shall be approved for the purpose.
- F. IEEE: Institute of Electrical and Electronics Engineers Standard 1015-1997 (Blue Book) Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

1.4 LABELING

- A. Nameplates and labeling shall be provided in accordance with Section 26 05 53. All feeders shall be labeled at the feeder device.

1.5 FINISHES

- A. All equipment shall have a factory applied gray finish applied over a rust inhibiting treatment. Any items which have the finish marred shall be touched up or refinished to a new condition before final acceptance. This shall include, but shall not be limited to, sanding and properly removing rust or other contaminants and completely repainting equipment if damage is extensive. Overall acceptance is subject to approval of the Engineer.

1.6 SUBMITTALS

- A. Provide complete product data for each equipment type. Provide electric service studies when required.
- B. Submittal shall include written recommendation from manufacturer of settings for all electronic trip adjustment setting on all equipment furnished with adjustable trip settings.

Contractor is responsible for adjusting all electronic trip settings per manufacturer recommendations.

- C. Electrical connections to all equipment furnished by any other division shall be coordinated with final approved equipment submittals from other divisions including but not limited to circuit breaker sizes, conduit sizes, wire sizes, fuse sizes, disconnect switch sizes and starter sizes that differ from those shown on the drawings prior to submitting Electrical Distribution Equipment submittal.

1.7 SHORT CIRCUIT CURRENT RATINGS

- A. General: All switchboards and panelboards shall be fully rated and marked with a maximum short circuit current rating. The equipment manufacturer shall have verified this rating with high-amperage testing. All short circuit current ratings are expressed as amperes RMS symmetrical at the applied voltage unless otherwise noted. All equipment shall withstand the specified level of fault current. All overcurrent devices shall interrupt the specified level of fault current.

1.8 ELECTRIC SERVICE STUDIES

- A. Standard: Submit studies in accordance with ANSI/IEEE Standard 242 Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- B. Submit one-line diagram for each electrical service. Key all equipment and components on diagram to items in the studies.
- C. Provide a short-circuit current analysis for each main switchboard. Short-circuit analysis shall calculate short-circuit levels at service transformer secondary, switchboard main breaker, each feeder breaker and all levels of downstream distribution equipment. Assume infinite source bus.
- D. Provide a time-current coordination study for each main switchboard. Coordination study shall compare the operating levels and times of the protective devices to the withstand levels and times that the equipment can sustain without damage or failure. Determine electronic trip unit settings necessary to achieve optimal selective coordination between 480 volt main service circuit breaker and first level of feeder distribution devices. Determine setting for all adjustments of trip units of all electronic circuit breakers that are linked by zone-selective-interlocking. Furnish time-current curves for the two (or more) levels of distribution protected with electronic trips, plus the first additional distribution level served from the switchboard feeder. Show a separate composite plot for each feeder breaker trip rating with the main breaker. Plot composite time-current curves on log-log background. Add a typical frame size of downstream molded-case circuit breaker to each switchboard feeder composite plot.
- E. Contractor shall make all adjustments to circuit breakers per electric service study and provide written documentation that all adjustments have been made.

1.9 OWNER'S INSTRUCTION

- A. Provide a four hour period of instruction to the Owner's designated personnel upon completion of the main switchboards installation. **Instruction shall include a functional**

training session on digital metering system operation and system test procedures. Demonstrate the transfer of metered values to the Building Automation System. Review manufacturer's recommended switchboard maintenance. The Operations and Maintenance Manual shall be complete and on-site at the time of Owner instruction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Unless indicated otherwise, all equipment in this section shall be provided from a single manufacturer. The product designations listed are to establish a level of quality. Acceptable manufacturers are,
1. Square D
 2. Siemens
 3. G.E.
 4. Cutler-Hammer

2.2 ENCLOSED SWITCHES

- A. General: Provide heavy duty enclosed switches similar to Square D Class 3100 Type HD.
- B. Switch Interior:
1. All switches shall have switch blades which are visible when the switch is OFF and the cover is open.
 2. Lugs shall be front removable and UL Listed for 75 degrees Celsius conductors.
 3. All current carrying parts shall be plated to resist corrosion.
 4. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.
 5. Switches shall have provisions for a field installable electrical interlock.
- C. Switch Mechanism:
1. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.
 2. The operating handle shall be an integral part of the box, not the cover.
 3. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.
 4. The handle position shall travel at least 90 degrees between OFF and ON positions to clearly distinguish and indicate handle position.
 5. All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- D. Switch Enclosures:
1. Switch covers shall be attached with welded pin-type hinges.
 2. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pre-treated steel.
 3. The enclosure shall have ON and OFF markings stamped into the cover.

4. The operating handle shall be provided with a dual colored, red/black position indication,
 5. All switches shall have provisions to accept up to three (3) 3/8 inch hasp padlocks to lock the operating handle in the OFF position.
 6. Tangential knockouts shall be provided to facilitate ease of conduit entry.
- E. Switch Ratings:
1. Switches shall be horsepower rated for ac and/or dc as indicated on the plans.
 2. The UL Listed short circuit current rating of the switches shall be 200,000 rms symmetrical amperes when used with or protected by Class J fuses.
 3. Non-Fusible: 10,000 rms symmetrical amps.
- F. Fuse Clips: NEMA FU 1, Class J fuses.

2.3 SINGLE CIRCUIT BREAKERS WITH ENCLOSURES

- A. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1, suitable for use as service entrance equipment where applied.
- B. Circuit Breakers: Molded case, quick make, quick break, trip free, common thermal magnetic trip.
- C. Ratings: Continuous current, poles as required, 480 volt system breaker shall interrupt short circuits up to 14,000 rms amps symmetrical; on 120/208 - 240 volt system, 10,000 amp rms symmetrical.
- D. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
 2. Exterior Locations: Type 3R.
- E. Nameplate: Provide a nameplate showing load served.

2.4 FRACTIONAL HORSEPOWER MANUAL MOTOR CONTROLLER

- A. Square D - Class 2510 Type F.
1. Description: NEMA ICS 2, ac general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light and toggle operator.
 2. Enclosures: ANSI / NEMA ICS 6, Type as indicated.

2.5 MAGNETIC MOTOR CONTROLLERS

- A. Square D - Class 8536 Type S.
1. Description: NEMA ICS 2, ac general-purpose Class A magnetic controller for induction motors rated in horsepower.
 2. Coil Operating Voltage: Provide as required to interface with controls system, including control power transformer.
 3. Coil: Be of encapsulated type.
 4. Poles: as indicated.
 5. Size: as indicated.

6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
7. Wiring: Straight-through wiring with all terminals clearly marked.
8. Overload Relay: NEMA ICS.
 - a. Solid State: Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
 - b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
 - c. Reset: Unit shall include both manual reset and remote reset using an external module.
 - d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
9. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.
10. Control Power Transformers: 120 volt secondary. VA minimum, in each motor starter. Provide fused primary and secondary.
11. Provide red LED running pilot light and H-O-A switch.

2.6 MAGNETIC MOTOR CONTROLLERS - TWO - SPEED

- A. Square D - Class 8810 Type S.
 1. Description: Include integral time delay transition between FAST and SLOW speeds. Starters shall be electrically and mechanically interlocked to prohibit both starters being energized simultaneously.
 2. Coil operating voltage: Provide as required to interface with controls system, including control power transformer.
 3. Coil: Be of encapsulated type.
 4. Poles: as indicated.
 5. Size: as indicated.
 6. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts.
 7. Contact inspection and replacement shall be possible without disturbing line or load wiring.
 8. Wiring: Straight-through wiring with all terminals clearly marked.
 9. Overload Relay: NEMA ICS.
 - a. Solid State; Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered. Provide phase loss, phase unbalance protection, permanent tamper guard, Trip Class 10 or 20 and a mechanical test function.
 - b. Outputs: Units shall be designed for addition of either a normally open or normally closed auxiliary contact and shall be field convertible. Provide one (1) set of N.O. and N.C. contacts in each starter.
 - c. Reset: Unit shall include both manual reset and remote reset using an external module.
 - d. Select overload current setting based on the motor nameplate data of the actual motor to be protected. All standard NEMA sizes may be used for the overload relay, including Size 00.
 10. Enclosure: ANSI / NEMA ICS 6, Type 1, 3R or 4X.

11. Two speed motor controllers shall be designed for type of motor winding specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.
12. Provide red-high, amber-low running pilot lights and H-O-L-A switch.
13. Provide two speed motor controllers for all two speed motors specified in Division 23 Mechanical Specifications, Drawings, or Equipment Schedule. Coordinate with Division 23 prior to submittal.

2.7 COMBINATION DISCONNECT / MOTOR STARTERS

- A. Square D - Class 8538 Type S (Fusible or no fuse, as shown on plans).
 1. Description: Combine magnetic motor controllers with fusible switch disconnect in common enclosure. Switch shall have a color coded externally operated handle. Operating handle shall give positive visual indication of ON/OFF with red and black color-coding.
 2. Fusible Switch Assemblies: NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate Class J fuses and visible blades. Operating handle shall give positive visual indication of ON/OFF with color-coded operating handle.
 3. Magnetic Motor Controllers: Refer to paragraph(s) specifying magnetic motor controllers for requirements.

2.8 FUSES (600 VOLTS AND BELOW)

- A. Manufacturers:
 1. Bussmann.
 2. Little Fuse
 3. Ferraz Shawmut
- B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.
- D. Class J (Time Delay) Fuses
 1. Dimensions and Performance: NEMA FU 1.
 2. Voltage: Rating suitable for circuit phase-to-phase voltage.
 3. Dual-element, time delay ten (10) seconds (minimum) at 500 percent rated current.
- E. Spares: Spare fuses shall be provided in the amount of ten (10) percent of each type and size installed. Replacement for fuses and limiters blown during construction shall not count as spares.

2.9 TWO-WINDING TRANSFORMERS

- A. Product Description: Provide transformers in accordance with the following standards, where applicable:
 1. Underwriter's Laboratory 1561, Standard for Safety for Dry-Type General Purpose and Power Transformers
 2. Underwriter's Laboratory 506, Standard for Safety for Specialty Transformers
 3. NEMA ST 20, Dry Type Transformers for General Applications
 4. NEMA 250, Enclosures for Electrical Equipment (1000 V Max)
 5. ANSI / IEEE C57.12.91, Standard Test Code for Dry-Type Distribution and Power Transformers

6. U.S. Department of Energy 10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule, dated April 18, 2013. These efficiency standards shall take effect January 1, 2016. All transformers covered in the scope of this document and this specification, manufactured after December 31, 2015, shall be compliant with the new standard.

- B. Ratings as indicated on Drawing.
- C. Primary Voltage: 480 volts, 3 phase or as indicated on plans.
- D. Secondary Voltage: 208Y/120 volts, 3 phase or as indicated on plans.
- E. Insulation system and average winding temperature rise 150 degrees Celsius over 40 degrees Celsius ambient.
- F. Winding Taps:
 1. 2 at 2.5 percent above rated voltage.
 2. 4 at 2.5 percent below rated voltage.

- G. Sound Levels: NEMA ST 20. Noise levels shall not exceed NEMA and ANSI Standards.
- H. Basic Impulse Level: 10 kV for transformers less than 300 kVA.
- I. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.
- J. Mounting:
 1. 1-15 kVA: Suitable for wall mounting.
 2. 16-75 kVA: Suitable for floor mounting.
 3. Larger than 75 kVA: Suitable for floor mounting.

- K. Coil Conductors: Continuous copper windings with terminations brazed or welded.
- L. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.
- M. Isolate core and coil from enclosure using vibration-absorbing mounts.
- N. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.10 TRANSFORMERS FOR NONLINEAR LOADS

- A. Nonlinear load transformer shall be as specified for two winding transformers except as modified by this Section.
- B. Product Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, designed to supply nonlinear load, UL K-9 rated.
- C. Primary Voltage: 480 volts, 3 phase.
- D. Secondary Voltage: 208Y/120 volts, 3 phase.

- E. Insulation and temperature rise: Class 220 insulation system with 115 degrees Celsius average winding temperature rise over 40 degrees Celsius ambient.
- F. Coil Conductors: Continuous copper windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at 1.73 times the phase conductor ampacity.
- G. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated. Furnish lifting eyes or brackets.
- H. Isolate core and coil from enclosure using vibration-absorbing mounts.
- I. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.11 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Square D I- Line, Class 2110.
- B. Product Description: NEMA PB 1, circuit breaker type panelboard.
- C. Panelboard Bus: copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
- D. Continuous current rating shall be sufficient to protect wiring and equipment served.
 - 1. Panels 400A and smaller, 35,000 amperes rms symmetrical.
 - 2. Panels greater than 400A: 65,000 amperes rms symmetrical.
- E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- F. Main Circuit Breaker:
 - 1. When distribution panel has main circuit breaker, provide molded case circuit breaker with electronic trip unit. Current sensing to be true-rms.
 - 2. Main breaker shall have minimum interrupting rating of 65,000 amperes rms symmetrical at applied voltage.
 - 3. Electronic trip shall be Square D micrologic with adjustable long-time, short-time and instantaneous pick-up set points.
- G. Cabinet Front: Safety dead front type. Conform to NEMA 1; NEMA 3R if located outdoors. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.

2.12 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers: Square D Type NQ for 208/120V, type NF for 480/277V.
- B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard;

- D. For non-linear load applications subject to harmonics furnish 173 percent rated, plated copper, solid neutral.
- E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 208-240/120 volt panelboards; 22,000 amperes rms symmetrical for 480 volt panelboards.
- F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.
- G. Enclosure: NEMA PB 1, Type 1 or Type 3R. All panelboards located in kitchen areas shall be flush mount with NEMA 4X Stainless Steel enclosures.
- H. Cabinet Front: Safety dead front type with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.
- I. Provide ground-fault circuit breaker for each heat trace branch circuit.
- J. Panelboards indicated to have thru-feed lugs shall be furnished with thru-feed lugs in all sections of panelboard.

2.13 MOTOR CONTROL CENTERS

- A. General:
 - 1. Provide totally enclosed, freestanding, motor control center with sections joined together to form one rigid unit. Motor control centers shall be similar to Square D Model 6 Class 8998.
 - 2. NEMA Class: I.
 - 3. NEMA Wiring Class: Type B.
 - 4. Standard: NEMA Standard ICS 2 Industrial Control and Systems.
 - 5. Underwriters Laboratories: UL 845 "Electric Motor Control Centers". Each vertical section shall be UL listed. Each motor control unit shall be UL listed.
- B. Installation: Freestanding on a four (4) inch concrete pad. Both the entire enclosure to the pad.
- C. Structure:
 - 1. Fabricated of code gage steel with steel doors formed into standardized units. Each vertical section shall have an independent isolated vertical wiring trough with full height hinged door. Back to back mounted devices in the same vertical bus module are unacceptable.
 - 2. Structures shall be totally enclosed, dead front, freestanding assemblies.
 - 3. Structure shall be NEMA type 1 gasketed general purpose.
 - 4. Motor control center structures shall have continuous removable base channels. The top plate(s) shall be removable to facilitate cutting of conduit entry openings.
 - 5. All steel parts shall be provided with a UL listed acrylic baked enamel or powder coat paint finish, except plated parts used for ground connections. All painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.
 - 6. Structures shall contain a minimum 12 inch high horizontal wireway at the top of each section and a minimum six (6) inch high horizontal wireway at the bottom of each section. These wireways shall run the full length of the motor control center to

allow room for power and control cable to connect between units in different sections.

7. A vertical wireway shall be provided in each motor control center section that accepts modular plug-in units. The vertical wireway shall connect with both the top and bottom horizontal wireways. The vertical wireway shall be barriered from control units and have a separate hinged door.
8. Unused spaces and spares shall have hinged doors.

D. Bussing:

1. Provide complete horizontal and vertical bussing with wiring spaces at top, bottom, and vertically in each section. All bussing shall be silver plated 98 percent conductivity copper.
2. The main horizontal bus shall be fully rated and shall extend the full length of the motor control center. Include provisions for splicing additional sections onto either end of the motor control center.
3. Each section that accepts plug-in units shall be provided with a vertical bus for distributing power from the main bus to the individual plug-in starter units. This bus shall be of the same material and plating as the main bus, and shall be rated no less than 125 percent of motor FLA in that section. Vertical bus shall extend full height of section, including all spare and space units. For purposes of calculating vertical bus ampacity, each space shall count no less than FLA of smallest motor served in that section.
4. A tin or silver plated copper ground bus shall be provided that runs the entire length of the motor control center. The ground bus shall be rated no less than 1/3 of horizontal main bus amps. Provide a vertical ground bus in each section used for plug-in units. Plug-in units shall have a ground stab arranged for first-make, last-break relative to the power bus stabs.
5. Motor control centers shall be separated into shipping blocks of no more than three vertical sections each.
6. All power bussing and splice connections shall be isolated from the unit compartments and the wireways. The horizontal bus shall be isolated from the horizontal wireways and starters. Barriers shall be removable to allow access to the bus and connections for maintenance.
7. The vertical bus shall be housed in modular glass filled polyester supports that provide bus insulation. These supports shall have openings every three (3) inches for unit stab-on connections. Each opening shall be provided with a closing plug to close off the stab opening.

E. Terminations:

1. Provide proper incoming line lugs. Size lugs to accommodate wire which is to be installed.
2. All starter units shall be provided with unit control terminal blocks.
3. Terminal blocks shall be the pull-apart type rated at 20 amps. The stationary portion shall be used for field connections and will remain attached to the cubicle when the unit is removed. The removable portion of the terminal blocks shall be used for the unit wiring factory connections.

F. Protective Devices:

1. Class J Fusible Switch-Starter Units: Plug in type with silver plated pressure type line disconnecting stabs of high strength copper alloy. Each unit shall be totally enclosed and effectively barriered, and shall be so designed that it can be located anywhere within the structure using the same overload heaters for the same load.

Fusible switches shall be manually operated quick make, quick break, horsepower rated. Coordinate fuses and overload heaters for proper acceleration time of motors provided. Operating handle shall clearly indicate ON or OFF. Provide for locking each switch in OFF position by 1 to 3 padlocks. Provide Class J fuse clips. Provide magnetic starter components as specified in Article MOTOR CONTROLLERS. Provide fuses field-installed in accordance with Article FUSES.

2. Circuit Breakers (with no motor controller): Molded case, bolted type, quick make, quick break, trip free, common thermal magnetic trips. Operating handle shall clearly indicate ON or OFF. Means shall be provided for locking each breaker in OFF position by one to three padlocks. Automatic tripping indicated by handle at center position.
3. Fused Switch (with no motor controller): Quick make, quick break, horsepower rated. Operating handle shall clearly indicate ON or OFF. Provide for locking each switch in OFF position by one to three padlocks. Provide Class J Type fuse clips. Provide fuses in accordance to Article FUSES located in this section.
4. Starters: all starters for motor control center to be size 1 minimum or larger.

G. Short Circuit Current Ratings:

1. Protective devices, together with the bussing and bracing, shall safely and without failure withstand and interrupt short circuits on a system capable of delivering up to 65,000 amps RMS symmetrical at nominal system voltage. Provide higher ratings when indicated on the Drawings.
2. Bus bracing shall be provided for the entire bus network to withstand the mechanical forces generated during the specified short circuit.
3. The main device serving the motor control center, every motor control unit and other overcurrent devices installed in the motor control center shall have an interrupt rating no less than the specified short circuit.
4. The entire motor control center shall be suitable for operation at the specified available fault current. The motor control center shall be labeled by the manufacturer to indicate the maximum available fault current rating, taking into account the structure, bussing, main feeder and all units and devices included in the motor control center. This fault current withstand rating shall be the basis for the UL Short-Circuit Current Rating.

H. Nameplate:

1. Identify each device with nameplate showing load served. Refer to "Labeling" in Section 16050.
2. Provide a master nameplate on face of units similar to following, with correct data shown:
Motor Control Center
480 Volts, 3 Phase, 3 Wire, 60 Hertz
Main Bus: ___ amps. braced for ___ amperes RMS Symmetrical
Date Installed:
3. Provide a nameplate for each vertical section marked with section characteristics and factory identification. This nameplate may be manufacturer's standard construction.
4. Provide UL listing marks on each section and unit in manufacturer's standard format.

I. Submittal: Include at least the following:

1. Manufacturer and Model Numbers
2. Dimensions
3. Cable Termination Provisions
4. Current Ratings

5. Voltage Ratings
6. Short Circuit Ratings including proof of any UL-listed series ratings (if series rating allowed by specification).
7. Motor Controller and Protective Device Ratings, including catalog pages for all current-limiting devices.
8. Identify NEMA Class of submitted mcc.
9. Identify NEMA Wiring Type of submitted mcc.
10. Single Phase Relay
11. Unit Elevation
12. Bussing Schematic, Sizes and statement of Conductor and Plating Material.
13. Original Manufacturer Brochure and Specifications

2.14 MAIN SWITCHBOARDS:

- A. General: Provide universal building-type switchboards fabricated in accordance with NEMA Standard PB-2, UL Standard 891, and bearing a UL Service Entrance Label. Switchboard characteristics are 480/277 volts, 3 phase, 4 wire. Main connection and unit-mounted branch connections shall be from the rear. Group mounted branch connections shall be from the front or the rear. The entire switchboard assembly shall be similar to Square D Type QED-2.
- B. Structure:
 1. The switchboard shall be freestanding and have front and rear alignment. Provide rear access to main device(s) and all unit-mount branch devices (2000A and less can be front access only). Provide front or rear access to group-mounted devices. Formed up steel channels bolted together to form a rigid structure to which formed up fronts, side sheets, and rear covers are bolted. Galvanized 1-1/2" x 3" mounting channels on bottom, rear, left, and right sides to close all openings at the bottom. Arrange for easy addition of future cubicles at end. Provide pull box, fabricated with unit at factory, on top of switchboard if required for proper entrances and exits of feeders.
 2. When "SPACE" is indicated on one-line diagram, provide full bussing extension to serve that space and all overcurrent device mounting hardware for the given frame size.
- C. Installation: Freestanding, level and bolted to a four (4) inch concrete pad.
- D. Instrumentation:
 1. General: Monitor the incoming line with a Square D Class 3020 ION S7650A0C0B6E0A0A. Meter shall have digital display adjustable to select phase. Monitor with an ammeter any feeder devices indicated on the Drawings.
 2. Wiring Lugs: Provide ring lugs for all wiring terminations of potential transformers (PTs), current transformers (CTs) and current sensors. Fork lugs are not acceptable. Ring lugs are intended to minimize the chance of leads pulling apart and creating an open circuit. (Zero current reading).

- E. Phase, Neutral and Ground Bussing: Silver plated 98% conductivity copper sized to comply with NEMA Temperature Rise Standard. In addition, copper bus shall be sized on the basis of a maximum temperature rise of 65 degree C. The vertical bussing per cubicle shall be sized not less than the sum of all devices, including spare spaces, to be served from that cubicle. **The vertical bus shall be a minimum of 2000 amperes and shall be full height.** Bus supports, connections, and joints shall be bolted with SAE Grade 5 medium carbon steel bolts employing Belleville washers. Provide complete bussing, mounting provisions for circuit protective devices and space screw cover wherever the drawings indicate space only. Arrange and drill bussing for **future full capacity extension**. Provide a full length ground bus, with minimum ampacity of 1/3 phase bus ampacity. Provide full-size neutral rated at 100 percent of phase bus.
- F. Terminations: Provide proper incoming line lugs to accommodate cable shown on plans.
- G. Short Circuit Ratings:
1. Switchboard assembly of protective devices, together with the bussing and bracing, shall be fully-rated to withstand and interrupt short circuits on a system capable of delivering up to **65,000** amps RMS symmetrical at nominal system voltage.
- H. Provisions for Auto Power Factor Controller (APFC):
1. Provide a circuit breaker with adjustable electronic tripping to protect and disconnect the automatic power factor controller.
 2. Set amp trip at minimum 150 percent of ampacity for the actual KVAR installed.
 3. Provide buss CTs on main incoming buss for use by the remote auto pf controller. These CTs shall be separate and in addition to all other CTs required for switchboard metering. Install a shorting terminal block on CT until the auto pf controller is installed at the job site.
 4. Refer to Section 26 35 33 for additional requirements of auto pf controller.
- I. Protective Devices:
1. Switchboard Main Breaker:
 - a. Stationary mounted, manually operated, 100 percent rated molded case circuit breakers with electronic tripping system and stored energy closing mechanisms. The electronic tripping system shall be similar to Square D Micrologic Full Function Trip unit. Main breakers shall be Square D **NW 3000-4000, RJ (1600-2500A) 65KA** ampere frame size.
 - b. The breaker shall be UL Listed for continuous duty at 100% of the current rating.
 - c. Minimum interrupting rating of **65,000** amperes rms symmetrical at 480/277 Volts.
 - d. Local trip indicators: overload, short circuit and ground fault.
 - e. Electronic sensing systems shall be true-RMS sensing and not susceptible to adverse harmonic current effects.
 - f. Adjustments:
 - 1) The electronic trip unit shall have LSIG Trip functions.
 2. Feeder Devices:
 - a. Breakers 700 Amps and Larger:
 - 1) Branch feeder breakers 700 amp and larger shall be molded case circuit breakers rated **100%** with electronic trip units, similar to Square D **NW (3000-4000A, RJ (1600-2500A 65kaic 100%)**

- 2) Interrupting rating shall be at least **65,000** amperes rms symmetrical at 480/277 Volts.
 - 3) The electronic trip unit shall have LSI trip functions.
 - 4) The breaker shall be UL Listed for continuous duty at 100% of the current rating.
- b. Breakers 600 amps and smaller shall be type L (600A and 400A frame), J (250A frame), and H (150A frame) molded circuit breakers, AIC rating to match main breaker.
- c. The breaker shall be UL Listed for continuous duty at 100% of the current rating
- J. Transient Voltage Surge Suppressor (TVSS):
1. General: Provide a Square D Class 1310 240kA surge current rated mounted in the switchboard mounted above the main circuit breaker compartment.
- K. Lightning and Overvoltage Surge Arrester:
1. General: Provide a Square D SDSA3650 lightning and overvoltage surge arrester inside the switchboard housing, connected between the service entrance bussing and the ground bus.
 2. Description: Device shall be a heavy duty, three-phase, zinc metal oxide varistor (MOV), secondary class arrester rated for 650 volts and U.L. listed in Category (OWHX) of the Electrical Construction Materials Directory (Green Book). Device shall comply with ANSI/IEEE C62.11-1987 Standard for Metal Oxide Surge Arresters for AC Power Circuits.
 3. Installation shall comply with NEC Article 280. Provide fusing if required by installation instructions from arrester manufacturer.
- L. Identification:
1. General: Identify each device and meter with a nameplate showing load served. Refer to Article on LABELING in Section 26 05 00.
 2. Master Nameplate: Provide a master nameplate on face of boards similar to following, with correct data shown:

Main Switchboard _____
480/277 Volts, 3 Phase, 4 Wire, 60 Hertz
Main Bus: ___ amps. braced for ___ RMS sym. amps.
Date Installed:
- M. Submittal: Include at least the following:
1. Manufacturer and Model Numbers
 2. Dimensions
 3. Cable Termination Provisions
 4. Current Ratings
 5. Voltage Ratings
 6. Short Circuit Ratings
 7. Protective Device Ratings
 8. Electronic metering system
 9. Surge Arrester
 10. Unit Elevation
 11. Bussing Schematic, Sizes and Statement of Conductor and Plating Materials

12. Original Manufacturer Brochure and Specifications
 13. Coordination drawing using dimensions of actual switchboard submitted. Show board footprint, proper clearances, and other equipment in same room.
- N. Testing: Test all devices and systems to assure proper operation.

2.15 SERVICE ENTRANCE CABLE TAP BOX (CTB):

A. Cable Tap Box:

1. General: Provide weatherproof, freestanding phase collection and cable tap box. Fabricate in strict accordance with Electric Utility requirements. Line side connection from building pad-mounted transformer shall be through underground conduit and wire, load side connections to the building main switchboard(s) shall be weatherproof outdoor busway.
2. Structure: Formed up steel channels bolted together to form a rigid structure to which formed-up fronts, side sheets, and rear covers are bolted. Front and rear doors shall be hinged. Galvanized 1-1/2 inch x 4 inches mounting channels on bottom, rear left, and right sides to close all side openings at the bottom. Interior framing shall be galvanized steel 1-5/8" rigid channel or approved equal system. Enclosure shall be tamper proof and outdoor weatherproof.
3. Installation: Freestanding and level on an outdoor concrete pad. Provide anchor bolts. Pad shall be outside all Electric Utility easements. Stub up conduits for Electric Utility service lateral and customer-side service entrance conduits. All underground conduit to/from CTB shall be concrete-encased.
4. Bussing: Insulated bussing, silver plated 98 percent conductivity copper. Bussing shall be sized in accordance with UL and NEMA Standards. In addition, size copper bus for not more than 1000 Amperes per cubic inch current density. Provide 3 phase, 4 wire, (100 percent neutral) bussing. Install with rigid supports to meet fault current rating.
5. Fault Current Rating: Bussing and bracing shall safely and without failure withstand short circuits on a system capable of delivering up to 100,000 amperes rms symmetrical at nominal system voltage. Install rope tie as required after cable installation to maintain bracing for short circuit current rating.

B. Electric Utility Requirements:

1. Prior to fabrication, submit three (3) prints of proposed cable tap box (CTB) to the representative designated by the Electric Utility. Submit prints only after shop drawings have been submitted and review cycle is complete with the Architect. Allow at least eight weeks time for review by Electric Utility prior to desired date of new service cut-in. Allow additional time for Architect/Engineer review prior to submittal to Electric Utility.
2. Cable tap box enclosure shall be tamper proof and weatherproof. Entire cabinet shall be tamper-resistant.
3. Form roof with cross-kink to force water to run off the cabinet.
4. Paint Finish Color: Match color of Electric Utility padmount transformer. Minimum finish shall be prime coat plus at least 6 mils of finish coat paint in two (2) applications.
5. Provide full-height doors on both utility side and customer side. Each door shall be hinged and have a vault-style handle with padlocking provisions. Electric Utility will install its padlock. Provide weatherproof padlock on customer door and give Owner ten (10) copies of key.
6. Fabricate CTB with two separate compartments; one side for Electric Utility connections and the opposite side for Customer connections. Compartments shall

be separated with an insulating barrier. Size cabinet to maintain necessary wire bending radius in Electric Utility and Customer compartments.

7. All insulating barriers shall be one (1) inch black phenolic resin, NEMA Grade N-1 or XX, or phenolite (Grade GPO-3).
 8. Each bus bar shall be copper, minimum 1/4 inch x 4 inches. Drill and tap for six (6) sets of 2-hole compression lugs per bus bar on Electric Utility side or other configuration stipulated by E.U. Lowest edge of all bus bars shall be 36 inches above top of concrete foundation. All bus bar dimensions, quantities, bracing and exact layout shall be per approved details from the Electric Utility for this specific job site. Parallel sufficient bus bars to achieve ampacity shown on Electrical Drawings for both Electric Utility and Customer side of CTB. Drill and tap for 2-hole NEMA D-tang compression lugs for termination of Customer cables.
 9. Install CTB level and bolted to a concrete foundation. Locate outside work space clearance and easements associated with Electric Utility padmount transformer and primary ductbank.
 10. Cable Termination: Terminate all cables with NEMA-pattern, two-hole, compression lugs.
- C. Submittal to A/E: Include at least the following:
1. Manufacturer and Model Numbers
 2. Dimensions: plan, elevations, bus bars.
 3. Cable Termination Provisions
 4. Current Rating
 5. Voltage Rating
 6. Short Circuit Withstand Rating
 7. Bussing Sizes, Layout and Statement of Conductor and Plating Materials
 8. Certify weatherproof cabinet construction. Certify paint finish type and thickness.
 9. Coordination Drawing showing cable tap box, Electric Utility padmount transformer with required work space clearances, meter location, and underground conduit entrances.
 10. After A/E shop drawing cycle is complete, submit three complete copies to Electric Utility.

2.16 SEQUENCING PANELBOARD FOR THEATER SOUND REINFORCEMENT SYSTEM:

- A. Features:
1. Supply all ac circuits for audio/visual equipment in the high school theater A/V room from time sequence panelboard capable of being remote controlled from multiple locations.
 2. 41 sequenced circuits per panelboard.
 3. A means of visual operator feedback shall provide an indication of the progress of the power turn-on and turn-off sequence at each control point.
 4. Sequencing shall have an adjustable time delay between the low level equipment circuits and the power amplifier circuits.
 5. The sequencing system shall be capable of shedding the load within three (3) seconds after a power failuer and re-sequencing when power resumes without operator intervention.
 6. Provide one LynTec Cat. No. SS-2 Sequencer Switch Set with every 41-circuit panelboard.
 7. Provide one LynTec Cat. No. SS-2PL Remote Locking Switch Plate with every 41-circuit panelboard.

8. Provide for each sequencing panelboard a LynTec Model No. SLC 341-41 filled with MB-Motorized Breakers, 3 phase, 4 wire, 208Y/120 Volt 225 Amp Main Breaker panel or approved equal.
 9. Acceptable Manufacturer: LynTec Inc., 8401 Melrose, Lenexa, KS 66214-1647; telephone 800-724-4047, fax 888-722-4157, www.lyntec.com or email info@lyntec.com.
- B. Cabinet: Safety dead front type; box made of Code gage galvanized steel; minimum gutter space 4" on all sides but not less than NEC requirements; door with flush type latch. Enclosure shall conform to NEMA 1.
- C. Circuit Breakers:
1. General: Provide a breaker for each audio branch circuit to protect wiring and equipment served.
 2. Description: Each breaker shall have motor drive for individual breaker remote control. Breakers shall be quick make, quick break, trip free, thermal magnetic trip. Automatic trip shall be indicated by the handle at the midpoint position. Multiple pole breakers shall have common trip.
- D. Short Circuit Ratings: 120/208 volt systems 10,000 amperes RMS symmetrical.
- E. Phase, Neutral and Ground Bussing: Silver or tin plated 98 percent conductivity copper sized in accordance with NEMA Temperature Rise Standards and installed completely throughout panel for installation of future breakers where schedule shows space only. Provide an equipment grounding bus bonded to the panel cabinet. Ground bus shall have a terminal screw for every breaker in the panel.
- F. Termination: Provide proper incoming line lugs. Size lugs to accommodate wire which is to be installed.
- G. Surge Protective Device: Install a Transient Voltage Surge Suppressor (TVSS) on the sequencing panelboard. TVSS shall be Current Technology TransGuard TG60 Series or Liebert Interceptor Model 111 Series.
- H. Nameplate: Nameplate on front face showing panel name and voltage. Coordinate to give same name as shown on Drawings.
- I. Directory: Complete at end of job, typewritten, contained in frame on the inside of the panel door. Frame shall have a protective plastic shield. Label every breaker to match directory.

2.17 ELEVATOR SHUNT TRIP DISCONNECT

- A. Provide Bussman Power Module Switch PS Series; amperage size and operating voltage shall match elevator branch circuit indicated on drawings.
- B. Provide control power transformer, fire alarm system interface relay, key-to-test switch, mechanical interlock auxiliary contact for hydraulic elevators with automatic recall.
- C. Interconnect with local heat detectors to provide elevator shutdown prior to the discharge of fire protection water in elevator machine room.

2.18 ROOF MOUNTED PEDESTALS

- A. Roof Utility Pedestal with 20 Amp GFCI/Weatherproof receptacle - Provide MAPA Products utility roof pedestal #MPX-20G: 36/12.

- B. Roof Pedestal with Non-Fused Disconnect Switch and 20 Amp GFCI/Weatherproof receptacle - Provide MAPA Products roof pedestal #MDP – (XX). See plans for disconnect sizes.

PART 3 - EXECUTION

3.1 MOUNTING:

- A. General: All equipment shall be securely fastened in place.
- B. Locations: In all cases mounting locations shall comply with the requirements of the National Electrical Code. This shall include providing suitable working clearances.
- C. Concrete Pads:
 - 1. Provide concrete in accordance with the Division of the Specifications for that product.
 - 2. Indoor concrete pads shall consist of a four (4) inch pad with beveled edges extending two (2) inches beyond the perimeter of supported equipment. Switchboards, motor control centers, transformers greater than 15 KVA, and engine generators shall be installed on a pad. Refer to the drawings and the specifications for each piece of equipment to determine what other equipment shall be mounted on a pad.
 - 3. All equipment, ground mounted outdoors, shall be mounted on a pad. Outdoor pads shall be minimum of one foot thick reinforced with #4 rebar one (1) foot on center each way. Size outdoor pads with at least four (4) feet working clearance in front of equipment and one (1) foot on all sides. Provide anchor bolts for pad-mounted equipment. Refer to Detail on drawings.
- D. Wall Mounted Equipment: Wall mounted equipment shall be suitably positioned on the wall. Equipment mounted on exterior basement wall shall have unistrut channels between the wall and the equipment to prevent condensation problems. Where wall mounted equipment is specified, but a convenient wall not available, a suitable unistrut mounting stanchion anchored in concrete shall be provided. In lieu of this stanchion, small devices may be mounted on to the equipment served if approved by the equipment manufacturer.
- E. Motor rated disconnects: Install disconnects in a vertical orientation with off in the down position.

3.2 DELIVERY, STORAGE AND HANDLING:

- A. General:
 - 1. Store all types of electrical power distribution equipment in a clean, heated building affording appropriate physical protection. Control access to prevent unauthorized tampering with the equipment. However, equipment may be stored in other inside or outside environments under approved conditions.
 - 2. Inspect equipment when received at Project site for shipping damage. Report as required by freight carrier to recover repair or replacement costs from the freight carrier in the event damage was sustained.
 - 3. Covers are required unless indoor, ventilated storage conditions exist. Canvas tarpaulins or the equivalent are preferred over other coverings because they provide

- better humidity control and enclosure scuff protection. Where exposed to moisture, covers shall be waterproof.
4. The manufacturer's shipping skids shall be left on the equipment to provide structural support until the equipment is set in final resting place.
 5. Refer to Section 26 05 00 for additional requirements. Contractor shall furnish new equipment to replace any equipment that is exposed to weather or subjected to other deleterious effects of construction.
- B. Approved Conditions for Equipment Storage:
1. General: Where storage conditions specified above are not available, indoor or outdoor storage shall comply with the following.
 2. Switchboards, Motor Control and Other General Distribution and Utilization Equipment:
 - a. Store metal-enclosed equipment in the upright position. Provide good ventilation of the shelter and protection from dirt, moisture and physical damage.
 - b. Space heaters furnished with the equipment shall be connected to a continuous source of power of the proper rating. Where space heaters are supplied from auxiliary power transformers, care shall be taken that low-voltage heater circuits are properly isolated before power source connection to prevent inadvertent energizing of the auxiliary transformer and associated high-voltage primary wiring.
 - c. Ambient conditions may allow condensation inside waterproof covers. If condensation is occurring, temporary heaters or lamp banks shall be provided of sufficient wattage to prevent condensation.
 - d. Contractor shall ensure that equipment stored in shipping cases receives adequate ventilation to avoid mildew and prevent condensation.
- C. Transformer
1. Indoor storage shall be provided for all transformers.

3.3 GROUND FAULT PROTECTION OF EQUIPMENT:

- A. General: Provide for system performance testing as required by the National Electrical Code. Provide each ground fault relay, sensing device or ground fault protection system with instructions and a test form. The form shall be retained by those in charge of the building's electrical installation and be available to the authority having jurisdiction. The instruction content shall be as required by UL.

3.4 TRANSFORMER VIBRATION ISOLATION:

- A. Floor Mounted Transformers: Install on concrete housekeeping pad with Mason Industries Type WM Neoprene Waffle pad, or equal. Provide Type WM isolation for elevated rack installation.
- B. Wall Mounted Transformers: Install Mason Industries Type WM Neoprene Waffle pad between the wall brackets and the wall.
- C. Suspended Transformers: Install Mason Industries PC30 Pre-compressed spring hanger with neoprene isolator.
- D. Floor Mounted Transformers Greater than 150 kVA: Install on Mason Industries, Inc, or equal, unhoused spring isolators with acoustical pad bonded to bottom. Isolators shall be

undamped free-standing spring isolators sized for a minimum of two (2) inches of static deflection. The spring outside diameter shall be no less than 80 percent of the spring operating height. The spring shall have remaining travel to solid of no less than 50 percent of the static deflection. Provide a 1/4 inch neoprene friction pad bonded to the spring base. Bolt each vibration isolator unit to concrete pad, and bolt transformers to the vibration isolator units, using the leveling bolts and nuts provided with the unit.

3.5 TRANSFORMER VENTILATION:

- A. Transformers with ventilating openings shall be installed so that the ventilating openings are not blocked by walls or other obstructions. The required clearances shall be clearly marked on the transformer.

3.6 POWER SHUT OFF UNDER KITCHEN HOODS:

- A. NFPA:
 - 1. Comply with NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations. The operation of any extinguishing system shall automatically shut off all sources of fuel and heat to all equipment requiring protection by that extinguishing system.
 - 2. Comply with NFPA 17, Standard for Dry Chemical Extinguishing Systems.
 - 3. Comply with NFPA 17A, Standard for Wet Chemical Extinguishing Systems.
- B. Shunt Trip: All electrical sources located under the ventilating equipment (cooking equipment hood) shall be shut off upon the operation of a wet chemical or water fire extinguishing system. Provide shunt trip accessory on each circuit breaker serving an electrical appliance under the hood. Install control wiring between shunt trips and the hood extinguishing system. Coordinate all wiring with supplier of hood fire suppression system for proper selection of shunt trip coil voltage, momentary or maintained-contact closure to activate shunt trip and inter-connections. Operation of a hood extinguishing system shall automatically shunt trip all associated circuit breakers.
- C. Fire Alarm System: The operation of any extinguishing system shall automatically signal the building fire alarm system. Refer to Section 26 05 53 for additional fire alarm system requirements.

3.7 LABELING:

- A. Nametag: Provide a nametag for each piece of distribution equipment; see Section 26 05 53, Electrical Identification.

END OF SECTION 26 20 00

SECTION 26 27 26 - WIRING DEVICES

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes wall switches; wall dimmers; receptacles; device plates and box covers. All devices shall be installed in outlet boxes of required size and volume.

1.3 REFERENCES

- A. National Electrical Manufacturers Association: Wiring devices shall comply with NEMA Standards WD-1 and WD-6.
- B. Wet Locations: Wiring devices and their enclosures installed outdoors and in wet locations shall be approved for that purpose.
- C. Minimum Raceway Size: 3/4 inch.

1.4 SUBMITTALS

- A. Submit manufactures product data for all wiring devices, indicate intended color and coverplate.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All devices shall be suitable for use intended, and have voltage and current ratings adequate for loads being served.

2.2 WALL SWITCHES

- A. Single Pole Switch, Toggle Style:
 - 1. Leviton 1221 Series, 20A, 120/277V.
- B. Double Pole Switch, Toggle Style:
 - 1. Leviton 1222 or 3032 Series, 20A or 30A, 120/277V.
- C. Three-way Switch, Toggle Style:
 - 1. Leviton 1223 Series, 20A, 120/277V.
- D. Four-way Switch, Toggle Style:

1. Leviton 1224 Series, 20A, 120/277V.
- E. Indicator Switch, Toggle Style:
 1. Leviton 1201 Series, 20A, 120/277V. Switch illuminated when load is on.
- F. Locator Switch, Toggle Style:
 1. Leviton 1221 Series, 20A, 120/277V. Switch illuminated when load is off.
- G. Digital Time Switch:
 1. Wattstopper TS-400 digital time switch with optional visual warning to flash lights at 5 minutes and 1 minute prior to time-out.
- H. Key lock switches:
 1. Provide key lock switches for corridor lighting and other locations indicated on electrical drawings.
 2. 20 Amp rated.
 3. 120/277 Volt ac rated.
 4. Key-lock mechanism can only be turned ON or OFF with key.
 5. Single pole: Leviton 1221-2KL or approved equal.
 6. 3-Way: Leviton 1223-2kl or approved equal.
 7. 4-Way: Leviton 1224-2kl or approved equal.
 8. Provide 302 stainless steel wall plate for each switch.
 9. Provide 2 keys on ring for each switch.
 10. Include a brass tag on every key switch ring. Engrave tag; Example: "Hall East Lights".
 11. Key all switches alike to match the owners standard key. Coordinate with school District for key match.
- I. Color: As selected by Architect.

2.3 MOTOR RATED SWITCHES

- A. Provide where a switch is indicated as a local disconnect for all mechanical and plumbing equipment.
- B. Leviton MMS Series.

2.4 WALL DIMMERS

- A. Manufacturers:
 1. Lutron Nova "T" Series.
- B. Product Description: Semiconductor dimmer for incandescent lamps with ON-OFF switch.
- C. Body and Handle: Linear slide handle, color as selected by Architect.
- D. Voltage: 120 volts.

2.5 RECEPTACLES

- A. Single Convenience Receptacle:
 - 1. Leviton 5362A Series, 20A/125V.
- B. Duplex Convenience Receptacle:
 - 1. Leviton 5362 Series, 20A/125V, respectively.
- C. GFCI Receptacle:
 - 1. Leviton 7899 Series, 20A/125V.
 - 2. Provide GFCI receptacles for all receptacles on 120v circuits installed in kitchens, bathrooms and outdoors (including rooftops).
- D. Isolated Ground Duplex Receptacle:
 - 1. Leviton 5362-IG, 20A/125V.
- E. Duplex Tamper Resistant Receptacle/ USB Charger
 - 1. Leviton T5832. Duplex 20A/125V receptacle with two 3.6A, 5VDC, 2.0 Type A USB Chargers.
- F. Provide 20 amp receptacle for single-receptacle branch circuits.
- G. For locations where a quadruplex or fourplex is required, provide 2-duplex receptacles under common coverplate.
- H. Color: As selected by Architect.

2.6 WALL PLATES

- A. Type 302 Stainless Steel with matching mounting screws.

2.7 MANUFACTURERS

- A. Each type of wiring device shall be furnished by one (1) manufacturer. The following will be acceptable providing the project specifications:
 - 1. Leviton
 - 2. Pass & Seymour
 - 3. Hubbell / Bryant
 - 4. Cooper

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect abandoned circuits and remove raceway, wire, and cable. Remove abandoned boxes when connecting wire and cable is abandoned and removed. Install blank cover for remaining abandoned boxes.
- B. Maintain access to existing boxes and wiring connections remaining active and requiring access.
- C. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.

3.2 INSTALLATION

- A. Route raceway and cable to meet Project conditions.
- B. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- C. Adjust box location up to ten (10) feet prior to rough-in when required to accommodate intended purpose.

- D. Do not install flush mounting box back-to-back in walls; install boxes with minimum 24 inches separation.

- E. Install devices plumb and level.

3.3 MOUNTING HEIGHTS

- A. As indicated on Drawings or if not indicated in accordance with the Architects instructions. All other telephone, Data, TV, etc. outlets shall be same as receptacle.

3.4 GANGED SWITCHES

- A. Install permanent barrier between all 277 Volt light switches ganged into one outlet box.
- B. Where multiple switches are grouped on one location, install switches under a one piece, multi-gang cover plate.
- C. Other telephone, data, TV, etc. outlets shall be same as receptacle.

3.5 GFCI

- A. Provide ground-fault circuit-interrupter type receptacles for all 15 and 20 amp receptacles shown on drawings in bathrooms, kitchens, mechanical rooms and outdoors.

END OF SECTION 26 27 26

SECTION 26 32 13 - EMERGENCY GENERATORS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide an emergency power system for emergency egress lighting, fire alarm system, emergency elevator operation, and other emergency power loads required.
- B. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.
- C. Products supplied but not installed under this section. Products shall be turned over to the Owner.
 - 1. Emergency generator system equipment as follows:
 - a. Complete set of all special tools required to operate and service the equipment as recommended by the manufacturer for field maintenance.
 - b. One oil filter replaceable element.
 - c. One air filter replaceable element.
- D. Related Sections:
 - 1. Division 1 - General Requirements
 - 2. Applicable sections of Division 16 - Electrical
 - 3. For emergency generators: Fuel gas piping, exhaust gas piping, flexible pipe connections, cooling air duct work, assembling generator accessories.
- E. Power Source: Provide an on-site engine-generator set to generate power for distribution to emergency and standby loads by the emergency power distribution system. Engine-generator set shall be constructed of all-new components.
- F. Transfer: Power to emergency loads shall be automatically transferred from normal utility power to the emergency engine generator upon loss of normal power. Transfer and assumption of load shall occur in ten (10) seconds or less. Loads shall be automatically retransferred upon restoration of normal source.
- G. Distribution System: Distribution equipment devices, and circuits shall be provided as required to distribute power to emergency loads.

1.3 REFERENCES

- A. Emergency generators shall be in accordance with the latest applicable standards as

recommended by, SAE, IEEE, and ANSI/NEMA MG-1 Motors and Generators.

1.4 SUBMITTALS

- A. Shop Drawings:
1. Emergency generator systems including:
 - a. Engine-generator set and foundation requirements.
 - b. Auxiliary and remote equipment.
 - c. Make of engine, number of cylinders, compression ratio, bore and stroke, cylinder displacement, and speed.
 - d. Make of generator, electrical rating, number and type of bearings, and exciter type.
 2. Plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
 3. Product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer and vibration isolators.
 4. Installation instructions.
 5. Name, location and phone number of nearest authorized distributor/service facility.
 6. Sequence of Operation - Manufacturer shall prepare a detailed, typewritten sequence of operation and submit as part of the approval documents. Final approved sequence of operation shall be permanently encapsulated in plastic laminate and permanently attached to the equipment. Format shall be 8½" x 11" or 11" x 17" as appropriate.
 7. Include schematic one-line diagram with appropriate symbols and nomenclature properly referenced to text.
- B. Product Data:
1. Specification Review: A complete item by item, line by line specification review.
 2. Output current Amperes and electrical kW rating of engine-generator set.
 3. Brake horsepower rating of engine.
 4. Fuel consumption at 100 percent, 75 percent and 50 percent load.
 5. Cooling requirements.
 6. Sound level (dBA measured on longitudinal and perpendicular axis at ten (10) feet).
 7. Manufacturer's technical data for generator, governor, voltage regulator, and battery charger. Governor submittal shall also identify method of overspeed protection to be furnished.
 8. Generator sub-transient reactance X_d'' , per unit
 9. Generator short circuit current, three-phase amperes.
 10. Generator voltage waveform distortion, measured at Full Load, line-neutral, both total harmonic distortion (THD) and maxim single harmonic order THD.
 11. Generator output circuit breaker(s), including proof or UL listing.
 12. Transfer Switch: Show complete data showing compliance. Include continuous and withstand current ratings of all contacts.
- C. Manuals and Test Data
1. Operation and Maintenance Manuals for all major components including instructions for normal operation, routine maintenance requirements, service

manuals for generator, engine, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.5 QUALITY ASSURANCE

- A. Authority Having Jurisdiction:
 - 1. General: The system shall comply with all applicable Codes and Ordinances as interpreted and enforced by the local authority having jurisdiction.

- B. National Electrical Code: The system shall comply with NFPA 70, National Electrical Code, including: 1) Article 445, 2) 700.

- C. NFPA:
 - 1. General: Comply with applicable requirements of NFPA Standards, including the following:
 - a. NFPA 37: Standard for Installation and Use of Stationary Combustion Engines and Gas Turbines.
 - b. NFPA 101: Life Safety Code.
 - c. NFPA 110: Standard for Emergency and Standby Power Systems.
 - 1) Type ten (10) seconds.
 - 2) Class 8 Diesel.
 - 3) Category B (engine-generator set).
 - 4) Level 1
 - d. NFPA 30: Flammable and Combustible Liquids Code.

- D. UL:
 - 1. General: Comply with applicable requirements of UL Standards, including the following.
 - a. UL 1008: Automatic Transfer Switches, Fourth Edition or later.
 - b. ANSI / NEMA: Comply with applicable requirements of ANSI / NEMA MG 1, "Motors and Generators", and MG 2, "Safety and Use of Electric Motors and Generators".
 - c. IEEE: Comply with applicable portions of IEEE Std 446-1987, "IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications" (Orange Book)
 - d. Texas Natural Resource Conservation Commission: TNRCC includes former Texas Water Commission (TWC) and Texas Air Control Board. Comply with applicable regulations of the TNRCC, including Texas Administrative Code (TAC) Title 31, Chapter 334 Underground and Aboveground Storage Tanks.

- E. EPA:
 - 1. General: Comply with all applicable EPA requirements.

1.6 OWNER'S INSTRUCTIONS

- A. Provide a four (4) hour period of instruction to the Owner's designated personnel upon completion of the system installation. Run engine-generator set and review remote annunciator panel for typical readings. Explain operation of generator remote stop switch. Demonstrate complete transfer sequence of utility-generator-utility. Operations & Maintenance Manual shall be complete and on-site for use during Owner's Instruction.

1.7 WARRANTY

- A. Furnish full parts and labor warranty to cover the entire engine generator package and automatic transfer switch including all accessories, components, controls, batteries, etc. for five years. Warranty shall begin from date of Certificate of Substantial Completion. Provide a sample of manufacturer's warranty certificates within equipment submittal. Warranty start dates from shipment or start up will not be accepted.
- B. In addition to full parts, labor, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, oils, lubricants, belts, filters, etc. and any expenses related to service calls required to diagnose and correct warranty issues. No purchase order number shall be required by the owner for service calls within warranty period. Purchase order number can be issued after problem is determined not to be a warranty issue.
- C. The manufacturer shall provide factory certificates for each Generator and associated Automatic Transfer Switch listing at a minimum the model, serial number and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.
- D. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing contractor.

1.8 MAINTENANCE

- A. Furnish one set of tools required for preventative maintenance of each engine generator system. Package tools in adequately sized metal tool box.
- B. Provide two spare sets of each oil, and air filter element required for each engine generator system.

PART 2 - PRODUCTS

2.1 GENERAL INFORMATION

- A. Furnish and install new diesel engine driven electric generating unit, factory assembled single unit generator set, with continuous output voltage of 480Y/277, 3 phase, 4 wire, at 0.8 power factor, 60 hertz, grounded neutral service, fully rated for operation at the job site altitude at an ambient temperature range of 120 degrees Fahrenheit maximum to -0 degrees Fahrenheit minimum, all mounted on a common steel base suitable for mounting on a concrete foundation pad, complete with a derangement panel and all accessories as specified and required for normal operation in standby service.
- B. Acceptable Manufacturers:
 - 1. Caterpillar
 - 2. Cummins/Onan
 - 3. Kohler

- C. Manual and Automatic Start - Unattended Operation
 - 1. Manual start shall be done by operating the “start” button on the generator or selecting "manual" on the manual-off-automatic selector switch on the automatic transfer switch.
 - 2. Automatic start shall be done by the automatic transfer switch when the manual-off-automatic selector switch on the automatic transfer switch is in the “automatic” position.

- D. Voltage and frequency regulation.
 - 1. Engine/generator shall deliver rated output (kVA) at rated frequency and power factor, at not more than two (2) percent above or below rated voltage.
 - 2. Voltage regulation shall be plus or minus two (2) percent for any constant load between no load and rated load. Random voltage variation shall not exceed ± 1 percent for any constant load. Voltage recovery to 100 percent normal output shall take no longer than two seconds after single step application of 100 percent rated load.
 - 3. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 1.8 hertz. Frequency adjustable from 57 hertz to 63 hertz (± 5 percent)
 - 4. The engine-generator set shall be capable of single step load pick up of 100 percent nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.

- E. The alternator shall produce a clean AC voltage waveform, with not more than five (5) percent total harmonic distortion at full linear load, when measured from line to neutral, and with not more than three (3) percent in any single harmonic.

- F. Furnish all necessary electrical connections, transfer switch, control panel, relays, etc., for installation of new generator set.

- G. Generator and engine shall be mounted on vibration isolating supports capable of 95 percent isolation to minimize vibration of the remainder of the skid-mounted equipment and transmission of vibration to the supporting pad.

- H. Generator shall be fully enclosed or suitably guarded to prevent exposure to all parts which operate at extremely high temperatures, electrically energized, or rotating. All noncurrent carrying parts shall be grounded.

- I. Thoroughly clean all equipment, and prime and finish paint with manufacturer's standard paint finish.

- J. Outdoor Weather-Protective Housing: Factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation and exclude entry of moisture into interior components. The housing shall have hinged side-access doors and rear control door. All doors shall be lockable. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color.

2.2 ENGINE

- A. Engine shall be standby power rated, multi-cylinder, [compression diesel four stroke cycle, liquid cooled, internal combustion engine for use with diesel fuel, industrial type, designed for full rated power output at 1800 rpm, 60 hertz. The engine shall be arranged for direct connection to the alternating current generator.
- B. Governor shall be electronic isochronous type no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Random frequency variation shall not exceed $\pm 0.25\%$ of its mean value for constant loads from no load to full load. Governor shall be provided with means for manual operation and adjustment.
- C. Lubrication system.
 - 1. Full pressure type with engine driven positive displacement sump pump,
 - 2. Full flow strainer,
 - 3. Full flow filter,
 - 4. Pressure relief and automatic bypass valves,
 - 5. Crankcase ventilator with filter and connection for outside venting,
 - 6. Bayonet type oil level indicating pressure gauges on the upstream and downstream side of the strainer and filter,
 - 7. Drain connection,
 - 8. Oil cooler,
 - 9. Low oil pressure safety shutoff device,
 - 10. Provide water shutoff valves and drain on the oil cooler to facilitate draining water without draining the complete engine cooling system.
 - 11. Provide a radiator coolant level sight glass.
- D. Cooling system.
 - 1. Pressure type, with radiator, blower type fan,
 - 2. Engine driven circulating pump,
 - 3. Radiator cap incorporating a pressure-vacuum valve,
 - 4. Thermostat in conjunction with a radiator bypass,
 - 5. Drain connection,
 - 6. High coolant temperature safety device,
 - 7. Fan shall be sized to maintain safe engine temperature in ambient temperature of 120 degrees Fahrenheit,
 - 8. Provide gaskets and packing in the cooling system which are unaffected by ethylene glycol base coolant,
 - 9. Provide a 50% ethylene glycol antifreeze solution for the coolant,
 - 10. Radiators shall be provided with a duct adapter flange permitting the attachment of air discharge duct for directing discharge air through the wall,
 - 11. Radiator and Air Intake/Discharge System Flow Restriction requirement shall be no less than 0.5 inches of water.
- E. Provide thermal circulation type engine jacket water heater with integral thermostatic control, sized to maintain minimum coolant temperature of 49 degrees Celsius down to an ambient temperature or 0 degrees Celsius. The heater shall be disconnected whenever the engine starts by an oil pressure switch mounted on engine. Connect heater to 120 volt normal power panel as indicated on Drawings. Install tag at connection on generator to identify power panel and circuit number.
- F. Air intake system shall be complete with a dry type filter, and high frequency filter-type silencer for reducing the sound level at the intake to a point acceptable for residential use.

- G. Air shutoff for emergency shutdown.
- H. Engine exhaust system shall be complete with stainless steel critical type silencer capable of reducing ambient exhaust noise level to 60 dBA when measured 50 feet from the engine under full engine load and clear weather. Silencer shall be supported independently of the engine. Flexible exhaust connection shall be provided from the engine exhaust manifold to the silencer. An exhaust condensation trap with manual drain valve shall be provided to prevent condensation from entering the engine. Furnish and install a steel rain cap at the exhaust stack outlet. Rain cap shall have a high-temp paint finish.
- I. Standard SAE nuts, bolts, and studs.
- J. Standard NPT or SAE tubing and fittings.
- K. Diesel Fuel System:
 - 1. General: Provide all fuel system components necessary to allow the generator system to operate under full load for a minimum of eight (8) hours.
 - 2. Engine: Include primary and secondary fuel filters with replaceable elements, an engine driven, mechanical positive displacement fuel pump, and vibration isolation flexible fuel line connectors, all mounted on the engine.
 - 3. Fuel Storage: Provide an integral fuel tank mounted between the generator skids. Features shall include:
 - a. Finish corrosion-resistant primer and painted to match generator.
 - b. Fill: Provide a two (2) manual fuel fill connection with cap.
 - c. Fuel Line Connections: Provide one for each fuel line, supply and return.
 - d. Drain: one (1) inch plugged.
 - e. Vent: Provide a vent connection for vent piping. Refer to Division 15 for vent piping.
 - f. Overflow: one (1) inch plugged.
 - g. Gages: Provide a fuel level gage.
 - h. Installation: Skid mounted on a four (4) inch concrete pad.
 - i. Fuel: Tank shall be full of fuel upon job completion.
 - j. The fuel tank shall be tank-in-tank construction with alarmed interstitial space. UL 142 listed.
 - k. Alarm: Provide a low-fuel sensor and wire out to remote indicator(s). Low fuel alarm level shall be adjusted for two (2) hours full-load run time.

2.3 GENERATOR

- A. Generator shall be alternating current, three phase, four pole, reconnectible brushless revolving field synchronous type with brushless exciter directly connected to the generator field windings without slip rings or commutators.
- B. Generator shall have a single prelubricated sealed bearing, direct connected to the engine, by means of a flexible disc coupling for self-alignment and air cooled by a direct drive centrifugal blower fan.
- C. Insulation shall be minimum Class F in a self-ventilated enclosure. Temperature rise shall be 130 degrees Celsius max over ANSI 40 degrees Celsius ambient for standby service.

- D. Bring out all leads from each winding to a generator main lead terminal box adequate in size for making up all connections and grounding the neutral to the generator set supporting frame.
- E. Voltage regulation shall include True RMS 3 phase sensing, generator-mounted volts per Hertz exciter-regulator to match engine and generator characteristics. Include manual controls to adjust voltage output plus or minus 5 percent of nominal voltage level.
- F. The generator shall have the necessary excitation control circuitry to prevent the loss of excitation on fault conditions allowing quick return to full voltage and power to normal and faulted circuits.
- G. Furnish NEMA 1 output terminal and outgoing cable termination compartment integral with the engine-generator frame.
- H. Output Breakers: Provide output molded case circuit breakers of adequate capacity and rating. Provide output breaker for each output circuit running from generator. Breaker shall be UL Listed 100 percent rated for continuous operation at full ampacity. Provide cable extensions and enclosure required to integrally mount output circuit breaker inside outdoor generator housing. Enclosure shall comply with NEC 404-3.
- I. Housing Alternator shall have an open drip-proof construction.

2.4 VOLTAGE REGULATION

- A. Static type, three phase, mounted either on the generator control panel or combined with the exciter. Voltage shall have "manual-automatic" switch and be adjustable +/- 10 percent under all operating conditions.

2.5 ELECTRIC STARTING SYSTEM

- A. Engine starting system shall be a 12 volt or 24 volt DC system depending on size of engine/generator, consisting of a heavy duty electric cranking motor(s) with drive mechanism, heavy duty batteries with metal frame or box, engine driven alternator, battery charger, and transistorized voltage regulator.
- B. Cranking motor shall be capable of starting the engine five times in rapid succession without overheating the motor and at sufficient speed for starting in low ambient temperatures.
- C. Storage batteries shall be lead acid type of voltage and capacity as determined by the engine manufacturer, with sufficient capacity to start the generator set five times consecutively in rapid succession. Provide all battery cables and connections. Provide hydrometer.
- D. Battery charger shall be an automatic, self-protected, self-regulated, dual rate rectifier type of a capacity determined by the engine manufacturer and sufficient to automatically recharge the batteries quickly according to the requirements governed by battery discharge duty, and suitable for 120 volt, single phase, 60 hertz input service from a remote receptacle panel.

2.6 ENGINE-GENERATOR CONTROL PANEL

- A. Control panel shall be engine generator frame mounted in NEMA 1 enclosure, totally front accessible. Control panel shall be completely factory pre-wired. All external connections shall be wired out to terminal blocks for field wiring. Control panel shall be complete with all engine and generator controls and indicators. Include front hinged double doors with latches and provision for padlock.
- B. Control panel shall provide a contact closure to initiate operation of the ventilation system. Wire out to terminal block. Contact shall be field wired by manufacturer as indicated on the Drawings.
- C. Control panel shall include the following fully identified by means of permanent nameplates:
 - 1. Control
 - a. Output voltage adjustment.
 - b. Cranking limiter relay.
 - c. Overspeed shutdown.
 - d. Low oil pressure shutdown.
 - e. High coolant temperature shutdown.
 - f. Remote Alarm Contacts: Pre-wired SPST contacts to terminal strip for remote indication of all alarm functions.
 - g. Battery operated service light to illuminate panel during power outage conditions.
 - h. Manual-off-auto engine start switch.
 - 2. Visual monitoring
 - a. Frequency Meter: 45-65 Hz range, 3½ inch (89 mm) dial.
 - b. AC Output Voltmeter: 3½ inch dial, two (2) percent accuracy, with phase selector switch (phase-to-phase and phase-to-ground).
 - c. AC Output Ammeter: 3½ inch dial, two (2) percent accuracy, with phase selector switch and 3 current transformers.
 - d. Push-to-test indicator lamps, one for each:
 - 1) Engine run
 - 2) Low oil pressure
 - 3) High water temperature
 - 4) Overspeed and overcrank
 - 5) Overspeed shutdown
 - 6) Failure to crank
 - 7) Failure to establish voltage or frequency.
 - 8) Failure to reach rated voltage at transfer switch in ten (10) seconds
 - e. Engine running time meter.
 - f. Electrical oil pressure gauge.
 - g. Electrical water temperature gauge.
 - h. Mechanical fuel pressure gauge.
 - i. Radiator sight glass.
 - j. DC voltmeter and ammeter.
 - 3. Audible monitoring
 - a. Low oil pressure alarm condition.
 - b. High coolant temperature alarm.
 - c. Failure to crank.
 - d. Failure to establish voltage or frequency.
 - e. Failure to reach rated voltage at transfer switch in ten (10) seconds.
- D. Battery charging system including alternator and solid state regulator.

- E. Remote Annunciator NFPA 110: Provide a remote annunciator to meet the requirements of NFPA 110, Level 1. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.
Locate annunciator in the Administration Area per owner's instruction.

2.7 WEATHER PROTECTIVE ENCLOSURE

- A. Standard Enclosure:
 - 1. Steel weather protective enclosure with 14 gauge sheet metal and a minimum ambient capability of 43 degrees Celsius (110 degrees Fahrenheit). Shall have removable, and / or hinged doors and removable end panels to allow easy routine maintenance. All hinges and latches shall be rust resistant and doors shall be equipped with rubber seals. A lockable service access cover shall be provided for easy access to the radiator fill cap. The enclosure shall be painted utilizing electrostatically applied powder baked paint.

2.8 AUTOMATIC TRANSFER SWITCHES

- A. Furnish and install automatic transfer switches (ATS) with four (4) poles, amperage, voltage, withstand and close-on ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.
- B. Acceptable Manufacturers:
 - 1. ASCO
 - 2. Russ Electric
 - 3. Zenith
 - 4. Kohler
 - 5. Cummins/Onan
- C. Mechanically Held Transfer Switch
 - 1. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.
 - 2. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
 - 3. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
 - 4. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
 - 5. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

6. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.
- D. Microprocessor Controller
1. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.
 2. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to ± 1 percent of nominal voltage. Frequency sensing shall be accurate to ± 0.2 percent. The panel shall be capable of operating over a temperature range of -20 to +60 degrees Celsius and storage from -55 to +85 degrees Celsius.
 3. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.
 4. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.
 5. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
 - a. EN 55011:1991 Emission standard - Group 1, Class A
 - b. EN 50082-2:1995 Generic immunity standard, from which:
 - 1) EN 61000-4-2:1995 Electrostatic discharge (ESD) immunity
 - 2) ENV 50140:1993 Radiated Electro-Magnetic field immunity
 - 3) EN 61000-4-4:1995 Electrical fast transient (EFT) immunity
 - 4) EN 61000-4-5:1995 Surge transient immunity
 - 5) EN 61000-4-6:1996 Conducted Radio-Frequency field immunity
 - c. IEEE472 (ANSI C37.90A) Ring Wave Test.
- E. Enclosure
1. The ATS shall be furnished in a Type 1 enclosure unless otherwise shown on the plans.
- F. Controller Display and Keypad
1. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and

limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:

- a. Nominal line voltage and frequency
- b. Single or three phase sensing
- c. Operating parameter protection
- d. Transfer operating mode configuration
 (Open transition, Closed transition, or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

G. Voltage, Frequency and Phase Rotation Sensing

- 1. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

<u>Parameter</u>	<u>Sources</u>	<u>Dropout / Trip</u>	<u>Pickup / Reset</u>
Undervoltage	N&E,3φ	70 to 98%	85 to 100%
Overvoltage	N&E,3φ	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

- 2. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 60°C.
- 3. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
- 4. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
- 5. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

H. Time Delays

- 1. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.
- 2. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
- 3. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
- 4. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

5. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:
 - a. Prior to transfer only.
 - b. Prior to and after transfer.
 - c. Normal to emergency only.
 - d. Emergency to normal only.
 - e. Normal to emergency and emergency to normal.
 - f. All transfer conditions or only when both sources are available.

- I. Additional Features
 1. A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.
 2. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
 3. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.
 4. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
 5. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.
 - a. The following features shall be built-in to the controller, but capable of being activated through keypad programming or the serial port only when required by the user:
 - 1) Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
 - 2) Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
 - 3) An Inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The inphase monitor shall be equal to ASCO Feature 27.

- J. Engine Exerciser: The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
1. Enable or disable the routine.
 2. Enable or disable transfer of the load during routine.
 3. Set the start time,
 - time of day
 - day of week
 - week of month (1st, 2nd, 3rd, 4th, alternate or every)
 4. Set the duration of the run.
At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
- K. Withstand and Close-On Ratings
1. The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.
 2. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.
- L. Tests and Certification
1. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- M. Service Representation
1. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide all work required for a complete system, including complete system testing and checkout. The installation of this system shall comply with the directions and recommendations of authorized factory representatives.

3.2 EMERGENCY DISTRIBUTION SYSTEM

- A. All boxes, and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system. Emergency circuits shall be specially marked and shall be run in raceway separate from normal powered circuits. All distribution equipment shall be specifically indicated "EMERGENCY" on the equipment nametag. Color code for emergency markings and all nametags shall be RED.

3.3 COMMISSIONING SERVICE

- A. A final inspection and an initial startup of the system shall be rendered by the authorized factory representatives.
- B. A letter of certification written by the authorized factory representatives, which states that the system is properly installed and does properly function as recommended by the factory and as described in this specification, shall be submitted to the Architect for his approval.
- C. A test run shall be performed by the authorized factory representative in the presence of the Owner, Architect and Engineer; the time of this test run shall be mutually agreed upon by all persons concerned. This test run may, but is not required to, coincide with other testing requirements described in this section.

3.4 INSTALLATION

- A. General: Provide all labor required for a complete installation.
- B. Mounting: Anchor on a four (4) inch concrete pad with bolts and elasto-rib vibration isolators. Pad shall extend a minimum of 18 inches from each side of the generator set skid.

3.5 CONSUMABLES

- A. Refuel during testing as required. After all tests have been performed, fuel tanks shall be filled before system is accepted by Owner. Check oil, coolant, batteries, filters and other consumables. Top off and replace as necessary to leave engine-generator set at full capacity for all consumables.

3.6 TESTING

- A. Factory Testing: The engine generator shall be tested at the factory, demonstrating its performance at full rated load. A certified copy of the test report shall accompany the unit to the field and shall be made available to the building official and copied to the Architect and Engineer.
- B. Field Testing: Conduct tests of the system as required by NEC Article 700 in the presence of the Owner, Architect, Engineer, and Code Authority having jurisdiction. The engine generator set shall demonstrate the actual sequencing of all load onto the generation unit and shall carry the building emergency loads, including any elevator(s), for a minimum period of two (2) hours. Contractor shall insure that all emergency loads are operational before scheduling this test. Test times shall be mutually agreed upon by all persons concerned.

3.7 SYSTEM GROUNDING

- A. The emergency power system generator output shall be grounded as a separately derived system according to the requirements of the Section titled GROUNDING. Bond the generator neutral to the generator ground.

3.8 SIGNS

- A. Refer to Section 16075, Electrical Identification for Sign Requirements.

- B. Service Entrance: A sign shall be placed at the normal power service entrance indicating location of the emergency power engine-generator set.
- C. Generator: Provide a sign arranged to be prominent and legible at the set control panel. Sign shall be an OSHA orange WARNING sign plus text. Sign text shall be "Warning - This equipment starts automatically. Disconnect all sources of supply and load before servicing", or similar approved text.
- D. Fuel Tank: Provide a "Caution - No Smoking" sign on the housing. Sign shall be an OSHA yellow caution sign with text and graphic no-smoking symbol. Provide sign per NFPA 110 Sect. 5.9.7 at both generator gas shut-off valve and building gas shut-off valve to indicate that there is another valve.

3.9 REMOTE WIRING

- A. General: Provide raceway, wiring and control cables from generator control panel to remote points. Underground conduits may be direct buried without concrete encasement if a red plastic warning tape is installed above each conduit.
- B. Remote Points:
 - 1. Engine-Generator Remote Panel
 - 2. Automatic Transfer Switches
 - 3. Automatic Battery Charger. Provide dc wiring from remote charger to battery rack at engine-generator set. Size wire for maximum 2 percent dc voltage drop at full load.
 - 4. Generator control power 120V branch circuit.
 - 5. Engine water jacket heater branch circuit.
 - 6. Outdoor generator housing: battery rack warming jacket 120V branch circuit.
 - 7. Outdoor generator housing: generator strip heater 120V branch circuit. One circuit may serve both jacket heater and generator heater if total load including voltage drop is less than 80% circuit ampacity.
 - 8. Elevator Controllers; (Signals shall be taken from ATS).
 - 9. Building Automation System (BAS); (BAS wires to the ATS).
 - 10. Building Security System
 - 11. Emergency Lighting Automatic Transfer Switches

3.10 EMERGENCY LIGHTING AUTOMATIC TRANSFER SWITCHES

- A. Provide automatic slave transfer switches where indicated on the drawings for transfer of dimmer branch circuits utilized for emergency lighting.

END OF SECTION 26 32 13

SECTION 26 32 13 - EMERGENCY GENERATORS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide an emergency power system for emergency egress lighting, fire alarm system, emergency elevator operation, and other emergency power loads required.
- B. Provide all labor, materials, and equipment as necessary to complete all work as indicated on the drawings, and as specified herein.
- C. Products supplied but not installed under this section. Products shall be turned over to the Owner.
 - 1. Emergency generator system equipment as follows:
 - a. Complete set of all special tools required to operate and service the equipment as recommended by the manufacturer for field maintenance.
 - b. One oil filter replaceable element.
 - c. One air filter replaceable element.
- D. Related Sections:
 - 1. Division 1 - General Requirements
 - 2. Applicable sections of Division 16 - Electrical
 - 3. For emergency generators: Fuel gas piping, exhaust gas piping, flexible pipe connections, cooling air duct work, assembling generator accessories.
- E. Power Source: Provide an on-site engine-generator set to generate power for distribution to emergency and standby loads by the emergency power distribution system. Engine-generator set shall be constructed of all-new components.
- F. Transfer: Power to emergency loads shall be automatically transferred from normal utility power to the emergency engine generator upon loss of normal power. Transfer and assumption of load shall occur in ten (10) seconds or less. Loads shall be automatically retransferred upon restoration of normal source.
- G. Distribution System: Distribution equipment devices, and circuits shall be provided as required to distribute power to emergency loads.

1.3 REFERENCES

- A. Emergency generators shall be in accordance with the latest applicable standards as

recommended by, SAE, IEEE, and ANSI/NEMA MG-1 Motors and Generators.

1.4 SUBMITTALS

- A. Shop Drawings:
1. Emergency generator systems including:
 - a. Engine-generator set and foundation requirements.
 - b. Auxiliary and remote equipment.
 - c. Make of engine, number of cylinders, compression ratio, bore and stroke, cylinder displacement, and speed.
 - d. Make of generator, electrical rating, number and type of bearings, and exciter type.
 2. Plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
 3. Product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer and vibration isolators.
 4. Installation instructions.
 5. Name, location and phone number of nearest authorized distributor/service facility.
 6. Sequence of Operation - Manufacturer shall prepare a detailed, typewritten sequence of operation and submit as part of the approval documents. Final approved sequence of operation shall be permanently encapsulated in plastic laminate and permanently attached to the equipment. Format shall be 8½" x 11" or 11" x 17" as appropriate.
 7. Include schematic one-line diagram with appropriate symbols and nomenclature properly referenced to text.
- B. Product Data:
1. Specification Review: A complete item by item, line by line specification review.
 2. Output current Amperes and electrical kW rating of engine-generator set.
 3. Brake horsepower rating of engine.
 4. Fuel consumption at 100 percent, 75 percent and 50 percent load.
 5. Cooling requirements.
 6. Sound level (dBA measured on longitudinal and perpendicular axis at ten (10) feet).
 7. Manufacturer's technical data for generator, governor, voltage regulator, and battery charger. Governor submittal shall also identify method of overspeed protection to be furnished.
 8. Generator sub-transient reactance X_d ", per unit
 9. Generator short circuit current, three-phase amperes.
 10. Generator voltage waveform distortion, measured at Full Load, line-neutral, both total harmonic distortion (THD) and maxim single harmonic order THD.
 11. Generator output circuit breaker(s), including proof or UL listing.
 12. Transfer Switch: Show complete data showing compliance. Include continuous and withstand current ratings of all contacts.
- C. Manuals and Test Data
1. Operation and Maintenance Manuals for all major components including instructions for normal operation, routine maintenance requirements, service

manuals for generator, engine, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.5 QUALITY ASSURANCE

- A. Authority Having Jurisdiction:
 - 1. General: The system shall comply with all applicable Codes and Ordinances as interpreted and enforced by the local authority having jurisdiction.

- B. National Electrical Code: The system shall comply with NFPA 70, National Electrical Code, including: 1) Article 445, 2) 700.

- C. NFPA:
 - 1. General: Comply with applicable requirements of NFPA Standards, including the following:
 - a. NFPA 37: Standard for Installation and Use of Stationary Combustion Engines and Gas Turbines.
 - b. NFPA 101: Life Safety Code.
 - c. NFPA 110: Standard for Emergency and Standby Power Systems.
 - 1) Type ten (10) seconds.
 - 2) Class 8 Natural gas utility pipeline.
 - 3) Category B (engine-generator set).
 - 4) Level 1
 - d. NFPA 54: National Fuel Gas Code.

- D. UL:
 - 1. General: Comply with applicable requirements of UL Standards, including the following.
 - a. UL 1008: Automatic Transfer Switches, Fourth Edition or later.
 - b. ANSI / NEMA: Comply with applicable requirements of ANSI / NEMA MG 1, "Motors and Generators", and MG 2, "Safety and Use of Electric Motors and Generators".
 - c. IEEE: Comply with applicable portions of IEEE Std 446-1987, "IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications" (Orange Book)

- E. EPA:
 - 1. General: Comply with all applicable EPA requirements.

1.6 OWNER'S INSTRUCTIONS

- A. Provide a four (4) hour period of instruction to the Owner's designated personnel upon completion of the system installation. Run engine-generator set and review remote annunciator panel for typical readings. Explain operation of generator remote stop switch. Demonstrate complete transfer sequence of utility-generator-utility. Operations & Maintenance Manual shall be complete and on-site for use during Owner's Instruction.

1.7 WARRANTY

- A. Furnish full parts and labor warranty to cover the entire engine generator package and automatic transfer switch including all accessories, components, controls, batteries, etc. for five years. Warranty shall begin from date of Certificate of Substantial Completion. Provide a sample of manufacturer's warranty certificates within equipment submittal. Warranty start dates from shipment or start up will not be accepted.
- B. In addition to full parts, labor, the Standard and Extended warranty shall include miscellaneous materials, travel time, incidental expenses, normal freight/shipping, oils, lubricants, belts, filters, etc. and any expenses related to service calls required to diagnose and correct warranty issues. No purchase order number shall be required by the owner for service calls within warranty period. Purchase order number can be issued after problem is determined not to be a warranty issue.
- C. The manufacturer shall provide factory certificates for each Generator and associated Automatic Transfer Switch listing at a minimum the model, serial number and warranty information as specified above. Payment to contractor may be held if warranty certificates are not provided in a timely manner.
- D. All warranty work shall be performed by factory direct service technician. Warranty work shall not be performed by installing contractor.

1.8 MAINTENANCE

- A. Furnish one set of tools required for preventative maintenance of each engine generator system. Package tools in adequately sized metal tool box.
- B. Provide two spare sets of each oil, and air filter element required for each engine generator system.

PART 2 - PRODUCTS

2.1 GENERAL INFORMATION

- A. Furnish and install new natural gas engine driven electric generating unit, factory assembled single unit generator set, with continuous output voltage of 480Y/277, 3 phase, 4 wire, at 0.8 power factor, 60 hertz, grounded neutral service, fully rated for operation at the job site altitude at an ambient temperature range of 120 degrees Fahrenheit maximum to -0 degrees Fahrenheit minimum, all mounted on a common steel base suitable for mounting on a concrete foundation pad, complete with a derangement panel and all accessories as specified and required for normal operation in standby service.
- B. Acceptable Manufacturers:
 - 1. Caterpillar
 - 2. Cummins/Onan
 - 3. Kohler
- C. Manual and Automatic Start - Unattended Operation

1. Manual start shall be done by operating the “start” button on the generator or selecting "manual" on the manual-off-automatic selector switch on the automatic transfer switch.
 2. Automatic start shall be done by the automatic transfer switch when the manual-off-automatic selector switch on the automatic transfer switch is in the “automatic” position.
- D. Voltage and frequency regulation.
1. Engine/generator shall deliver rated output (kVA) at rated frequency and power factor, at not more than two (2) percent above or below rated voltage.
 2. Voltage regulation shall be plus or minus two (2) percent for any constant load between no load and rated load. Random voltage variation shall not exceed ± 1 percent for any constant load. Voltage recovery to 100 percent normal output shall take no longer than two seconds after single step application of 100 percent rated load.
 3. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 1.8 hertz. Frequency adjustable from 57 hertz to 63 hertz (± 5 percent)
 4. The engine-generator set shall be capable of single step load pick up of 100 percent nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
- E. The alternator shall produce a clean AC voltage waveform, with not more than five (5) percent total harmonic distortion at full linear load, when measured from line to neutral, and with not more than three (3) percent in any single harmonic.
- F. Furnish all necessary electrical connections, transfer switch, control panel, relays, etc., for installation of new generator set.
- G. Generator and engine shall be mounted on vibration isolating supports capable of 95 percent isolation to minimize vibration of the remainder of the skid-mounted equipment and transmission of vibration to the supporting pad.
- H. Generator shall be fully enclosed or suitably guarded to prevent exposure to all parts which operate at extremely high temperatures, electrically energized, or rotating. All noncurrent carrying parts shall be grounded.
- I. Thoroughly clean all equipment, and prime and finish paint with manufacturer's standard paint finish.
- J. Outdoor Weather-Protective Housing: Factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation and exclude entry of moisture into interior components. The housing shall have hinged side-access doors and rear control door. All doors shall be lockable. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color.

2.2 ENGINE

- A. Engine shall be standby power rated, multi-cylinder, spark ignited four stroke cycle, liquid cooled, internal combustion engine for use with natural gas fuel, industrial type, designed

for full rated power output at 1800 rpm, 60 hertz. The engine shall be arranged for direct connection to the alternating current generator.

- B. Governor shall be electronic isochronous type no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Random frequency variation shall not exceed $\pm 0.25\%$ of its mean value for constant loads from no load to full load. Governor shall be provided with means for manual operation and adjustment.
- C. Lubrication system.
 - 1. Full pressure type with engine driven positive displacement sump pump,
 - 2. Full flow strainer,
 - 3. Full flow filter,
 - 4. Pressure relief and automatic bypass valves,
 - 5. Crankcase ventilator with filter and connection for outside venting,
 - 6. Bayonet type oil level indicating pressure gauges on the upstream and downstream side of the strainer and filter,
 - 7. Drain connection,
 - 8. Oil cooler,
 - 9. Low oil pressure safety shutoff device,
 - 10. Provide water shutoff valves and drain on the oil cooler to facilitate draining water without draining the complete engine cooling system.
 - 11. Provide a radiator coolant level sight glass.
- D. Cooling system.
 - 1. Pressure type, with radiator, blower type fan,
 - 2. Engine driven circulating pump,
 - 3. Radiator cap incorporating a pressure-vacuum valve,
 - 4. Thermostat in conjunction with a radiator bypass,
 - 5. Drain connection,
 - 6. High coolant temperature safety device,
 - 7. Fan shall be sized to maintain safe engine temperature in ambient temperature of 120 degrees Fahrenheit,
 - 8. Provide gaskets and packing in the cooling system which are unaffected by ethylene glycol base coolant,
 - 9. Provide a 50% ethylene glycol antifreeze solution for the coolant,
 - 10. Radiators shall be provided with a duct adapter flange permitting the attachment of air discharge duct for directing discharge air through the wall,
 - 11. Radiator and Air Intake/Discharge System Flow Restriction requirement shall be no less than 0.5 inches of water.
- E. Provide thermal circulation type engine jacket water heater with integral thermostatic control, sized to maintain minimum coolant temperature of 49 degrees Celsius down to an ambient temperature or 0 degrees Celsius. The heater shall be disconnected whenever the engine starts by an oil pressure switch mounted on engine. Connect heater to 120 volt normal power panel as indicated on Drawings. Install tag at connection on generator to identify power panel and circuit number.
- F. Air intake system shall be complete with a dry type filter, and high frequency filter-type silencer for reducing the sound level at the intake to a point acceptable for residential use.
- G. Air shutoff for emergency shutdown.

- H. Engine exhaust system shall be complete with stainless steel critical type silencer capable of reducing ambient exhaust noise level to 60 dBA when measured 50 feet from the engine under full engine load and clear weather. Silencer shall be supported independently of the engine. Flexible exhaust connection shall be provided from the engine exhaust manifold to the silencer. An exhaust condensation trap with manual drain valve shall be provided to prevent condensation from entering the engine. Furnish and install a steel rain cap at the exhaust stack outlet. Rain cap shall have a high-temp paint finish.
- I. Standard SAE nuts, bolts, and studs.
- J. Standard NPT or SAE tubing and fittings.
 - a. Alarm: Provide a low-fuel sensor and wire out to remote indicator(s). Low fuel alarm level shall be adjusted for two (2) hours full-load run time.
- L. Gas Train for Natural Gas Fuel System:
 - 1. General: Provide all fuel system components necessary to allow the generator system to operate under continuous emergency full load. Gas regulator train assembly shall be designed for engine manufacturer's recommended gas pressure from a nominal five (5) pound per-square-inch natural gas service. Install components furnished with engine.
 - 2. Engine-mounted carburetor.
 - 3. Fuel gas pressure regulators with vibration isolating, flexible fuel line joint on gas-supply side.
 - 4. Solenoid valve that automatically shuts off flow of gas if the engine stops for any reason. Install this valve on gas-supply side of gas pressure regulator.
 - 5. Gas pressure gauge with analog display of ounces-per-square-inch to monitor gas supply pressure. Install this gauge in gas train inside the generator set housing.
 - 6. Gas line service regulator with atmospheric vent.
 - 7. Dry filter for vapor withdrawal.
 - 8. Manual shut-off valve.
 - 9. Gas surge tank or other components as may be recommended by engine supplier.
 - 10. Gas fuel line for Emergency Power System shall be connected ahead of the main gas shutoff valve for the building with a separate, dedicated shutoff valve. Mark both generator gas valve and building gas valve with permanent signs to indicate that there is another valve, per NFPA 110, sect. 5-9.7.

2.3 GENERATOR

- A. Generator shall be alternating current, three phase, four pole, reconnectible brushless revolving field synchronous type with brushless exciter directly connected to the generator field windings without slip rings or commutators.
- B. Generator shall have a single prelubricated sealed bearing, direct connected to the engine, by means of a flexible disc coupling for self-alignment and air cooled by a direct drive centrifugal blower fan.

- C. Insulation shall be minimum Class F in a self-ventilated enclosure. Temperature rise shall be 130 degrees Celsius max over ANSI 40 degrees Celsius ambient for standby service.
- D. Bring out all leads from each winding to a generator main lead terminal box adequate in size for making up all connections and grounding the neutral to the generator set supporting frame.
- E. Voltage regulation shall include True RMS 3 phase sensing, generator-mounted volts per Hertz exciter-regulator to match engine and generator characteristics. Include manual controls to adjust voltage output plus or minus 5 percent of nominal voltage level.
- F. The generator shall have the necessary excitation control circuitry to prevent the loss of excitation on fault conditions allowing quick return to full voltage and power to normal and faulted circuits.
- G. Furnish NEMA 1 output terminal and outgoing cable termination compartment integral with the engine-generator frame.
- H. Output Breakers: Provide output molded case circuit breakers of adequate capacity and rating. Provide output breaker for each output circuit running from generator. Breaker shall be UL Listed 100 percent rated for continuous operation at full ampacity. Provide cable extensions and enclosure required to integrally mount output circuit breaker inside outdoor generator housing. Enclosure shall comply with NEC 404-3.
- I. Housing Alternator shall have an open drip-proof construction.

2.4 VOLTAGE REGULATION

- A. Static type, three phase, mounted either on the generator control panel or combined with the exciter. Voltage shall have "manual-automatic" switch and be adjustable +/- 10 percent under all operating conditions.

2.5 ELECTRIC STARTING SYSTEM

- A. Engine starting system shall be a 12 volt or 24 volt DC system depending on size of engine/generator, consisting of a heavy duty electric cranking motor(s) with drive mechanism, heavy duty batteries with metal frame or box, engine driven alternator, battery charger, and transistorized voltage regulator.
- B. Cranking motor shall be capable of starting the engine five times in rapid succession without overheating the motor and at sufficient speed for starting in low ambient temperatures.
- C. Storage batteries shall be lead acid type of voltage and capacity as determined by the engine manufacturer, with sufficient capacity to start the generator set five times consecutively in rapid succession. Provide all battery cables and connections. Provide hydrometer.
- D. Battery charger shall be an automatic, self-protected, self-regulated, dual rate rectifier type of a capacity determined by the engine manufacturer and sufficient to automatically recharge the batteries quickly according to the requirements governed by battery discharge duty, and suitable for 120 volt, single phase, 60 hertz input service from a remote receptacle panel.

2.6 ENGINE-GENERATOR CONTROL PANEL

- A. Control panel shall be engine generator frame mounted in NEMA 1 enclosure, totally front accessible. Control panel shall be completely factory pre-wired. All external connections shall be wired out to terminal blocks for field wiring. Control panel shall be complete with all engine and generator controls and indicators. Include front hinged double doors with latches and provision for padlock.
- B. Control panel shall provide a contact closure to initiate operation of the ventilation system. Wire out to terminal block. Contact shall be field wired by manufacturer as indicated on the Drawings.
- C. Control panel shall include the following fully identified by means of permanent nameplates:
 - 1. Control
 - a. Output voltage adjustment.
 - b. Cranking limiter relay.
 - c. Overspeed shutdown.
 - d. Low oil pressure shutdown.
 - e. High coolant temperature shutdown.
 - f. Remote Alarm Contacts: Pre-wired SPST contacts to terminal strip for remote indication of all alarm functions.
 - g. Battery operated service light to illuminate panel during power outage conditions.
 - h. Manual-off-auto engine start switch.
 - 2. Visual monitoring
 - a. Frequency Meter: 45-65 Hz range, 3½ inch (89 mm) dial.
 - b. AC Output Voltmeter: 3½ inch dial, two (2) percent accuracy, with phase selector switch (phase-to-phase and phase-to-ground).
 - c. AC Output Ammeter: 3½ inch dial, two (2) percent accuracy, with phase selector switch and 3 current transformers.
 - d. Push-to-test indicator lamps, one for each:
 - 1) Engine run
 - 2) Low oil pressure
 - 3) High water temperature
 - 4) Overspeed and overcrank
 - 5) Overspeed shutdown
 - 6) Failure to crank
 - 7) Failure to establish voltage or frequency.
 - 8) Failure to reach rated voltage at transfer switch in ten (10) seconds
 - e. Engine running time meter.
 - f. Electrical oil pressure gauge.
 - g. Electrical water temperature gauge.
 - h. Mechanical fuel pressure gauge.
 - i. Radiator sight glass.
 - j. DC voltmeter and ammeter.
 - 3. Audible monitoring
 - a. Low oil pressure alarm condition.
 - b. High coolant temperature alarm.
 - c. Failure to crank.
 - d. Failure to establish voltage or frequency.
 - e. Failure to reach rated voltage at transfer switch in ten (10) seconds.

- D. Battery charging system including alternator and solid state regulator.
- E. Remote Annunciator NFPA 110: Provide a remote annunciator to meet the requirements of NFPA 110, Level 1. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn.
Locate annunciator in the Administration Area per owner's instruction.

2.7 WEATHER PROTECTIVE ENCLOSURE

- A. Standard Enclosure:
 - 1. Steel weather protective enclosure with 14 gauge sheet metal and a minimum ambient capability of 43 degrees Celsius (110 degrees Fahrenheit). Shall have removable, and / or hinged doors and removable end panels to allow easy routine maintenance. All hinges and latches shall be rust resistant and doors shall be equipped with rubber seals. A lockable service access cover shall be provided for easy access to the radiator fill cap. The enclosure shall be painted utilizing electrostatically applied powder baked paint.

2.8 AUTOMATIC TRANSFER SWITCHES

- A. Furnish and install automatic transfer switches (ATS) with four (4) poles, amperage, voltage, withstand and close-on ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.
- B. Acceptable Manufacturers:
 - 1. ASCO
 - 2. Russ Electric
 - 3. Zenith
 - 4. Kohler
 - 5. Cummins/Onan
- C. Mechanically Held Transfer Switch
 - 1. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.
 - 2. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
 - 3. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
 - 4. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.
 - 5. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power

conductors. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

6. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

D. Microprocessor Controller

1. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.
2. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to ± 1 percent of nominal voltage. Frequency sensing shall be accurate to ± 0.2 percent. The panel shall be capable of operating over a temperature range of -20 to +60 degrees Celsius and storage from -55 to +85 degrees Celsius.
3. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.
4. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.
5. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
 - a. EN 55011:1991 Emission standard - Group 1, Class A
 - b. EN 50082-2:1995 Generic immunity standard, from which:
 - 1) EN 61000-4-2:1995 Electrostatic discharge (ESD) immunity
 - 2) ENV 50140:1993 Radiated Electro-Magnetic field immunity
 - 3) EN 61000-4-4:1995 Electrical fast transient (EFT) immunity
 - 4) EN 61000-4-5:1995 Surge transient immunity
 - 5) EN 61000-4-6:1996 Conducted Radio-Frequency field immunity
 - c. IEEE472 (ANSI C37.90A) Ring Wave Test.

E. Enclosure

1. The ATS shall be furnished in a Type 1 enclosure unless otherwise shown on the plans.

F. Controller Display and Keypad

1. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:
 - a. Nominal line voltage and frequency
 - b. Single or three phase sensing
 - c. Operating parameter protection
 - d. Transfer operating mode configuration
(Open transition, Closed transition, or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

G. Voltage, Frequency and Phase Rotation Sensing

1. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

<u>Parameter</u>	<u>Sources</u>	<u>Dropout / Trip</u>	<u>Pickup / Reset</u>
Undervoltage	N&E,3φ	70 to 98%	85 to 100%
Overvoltage	N&E,3φ	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

2. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 60°C.
3. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.
4. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
5. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

H. Time Delays

1. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.
2. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
3. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

4. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
 5. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:
 - a. Prior to transfer only.
 - b. Prior to and after transfer.
 - c. Normal to emergency only.
 - d. Emergency to normal only.
 - e. Normal to emergency and emergency to normal.
 - f. All transfer conditions or only when both sources are available.
- I. Additional Features
1. A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.
 2. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
 3. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.
 4. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
 5. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.
 - a. The following features shall be built-in to the controller, but capable of being activated through keypad programming or the serial port only when required by the user:
 - 1) Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
 - 2) Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
 - 3) An Inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The inphase monitor shall be equal to ASCO Feature 27.

- J. Engine Exerciser: The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
1. Enable or disable the routine.
 2. Enable or disable transfer of the load during routine.
 3. Set the start time,
 - time of day
 - day of week
 - week of month (1st, 2nd, 3rd, 4th, alternate or every)
 4. Set the duration of the run.

At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
- K. Withstand and Close-On Ratings
1. The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.
 2. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.
- L. Tests and Certification
1. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- M. Service Representation
1. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide all work required for a complete system, including complete system testing and checkout. The installation of this system shall comply with the directions and recommendations of authorized factory representatives.

3.2 EMERGENCY DISTRIBUTION SYSTEM

- A. All boxes, and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system. Emergency circuits shall be specially marked and shall be run in raceway separate from normal powered circuits. All distribution equipment shall be specifically indicated "EMERGENCY" on the equipment nametag. Color code for emergency markings and all nametags shall be RED.

3.3 COMMISSIONING SERVICE

- A. A final inspection and an initial startup of the system shall be rendered by the authorized factory representatives.
- B. A letter of certification written by the authorized factory representatives, which states that the system is properly installed and does properly function as recommended by the factory and as described in this specification, shall be submitted to the Architect for his approval.
- C. A test run shall be performed by the authorized factory representative in the presence of the Owner, Architect and Engineer; the time of this test run shall be mutually agreed upon by all persons concerned. This test run may, but is not required to, coincide with other testing requirements described in this section.

3.4 INSTALLATION

- A. General: Provide all labor required for a complete installation.
- B. Mounting: Anchor on a four (4) inch concrete pad with bolts and elasto-rib vibration isolators. Pad shall extend a minimum of 18 inches from each side of the generator set skid.

3.5 CONSUMABLES

- A. Refuel during testing as required. After all tests have been performed, fuel tanks shall be filled before system is accepted by Owner. Check oil, coolant, batteries, filters and other consumables. Top off and replace as necessary to leave engine-generator set at full capacity for all consumables.

3.6 TESTING

- A. Factory Testing: The engine generator shall be tested at the factory, demonstrating its performance at full rated load. A certified copy of the test report shall accompany the unit to the field and shall be made available to the building official and copied to the Architect and Engineer.
- B. Field Testing: Conduct tests of the system as required by NEC Article 700 in the presence of the Owner, Architect, Engineer, and Code Authority having jurisdiction. The engine generator set shall demonstrate the actual sequencing of all load onto the generation unit and shall carry the building emergency loads, including any elevator(s), for a minimum period of two (2) hours. Contractor shall insure that all emergency loads are operational before scheduling this test. Test times shall be mutually agreed upon by all persons concerned.

3.7 SYSTEM GROUNDING

- A. The emergency power system generator output shall be grounded as a separately derived system according to the requirements of the Section titled GROUNDING. Bond the generator neutral to the generator ground.

3.8 SIGNS

- A. Refer to Section 16075, Electrical Identification for Sign Requirements.
- B. Service Entrance: A sign shall be placed at the normal power service entrance indicating location of the emergency power engine-generator set.
- C. Generator: Provide a sign arranged to be prominent and legible at the set control panel. Sign shall be an OSHA orange WARNING sign plus text. Sign text shall be "Warning - This equipment starts automatically. Disconnect all sources of supply and load before servicing", or similar approved text.
- D. Fuel Tank: Provide a "Caution - No Smoking" sign on the housing. Sign shall be an OSHA yellow caution sign with text and graphic no-smoking symbol. Provide sign per NFPA 110 Sect. 5.9.7 at both generator gas shut-off valve and building gas shut-off valve to indicate that there is another valve.

3.9 REMOTE WIRING

- A. General: Provide raceway, wiring and control cables from generator control panel to remote points. Underground conduits may be direct buried without concrete encasement if a red plastic warning tape is installed above each conduit.
- B. Remote Points:
 - 1. Engine-Generator Remote Panel
 - 2. Automatic Transfer Switches
 - 3. Automatic Battery Charger. Provide dc wiring from remote charger to battery rack at engine-generator set. Size wire for maximum 2 percent dc voltage drop at full load.
 - 4. Generator control power 120V branch circuit.
 - 5. Engine water jacket heater branch circuit.
 - 6. Outdoor generator housing: battery rack warming jacket 120V branch circuit.
 - 7. Outdoor generator housing: generator strip heater 120V branch circuit. One circuit may serve both jacket heater and generator heater if total load including voltage drop is less than 80% circuit ampacity.
 - 8. Elevator Controllers; (Signals shall be taken from ATS).
 - 9. Building Automation System (BAS); (BAS wires to the ATS).
 - 10. Building Security System
 - 11. Emergency Lighting Automatic Transfer Switches

3.10 EMERGENCY LIGHTING AUTOMATIC TRANSFER SWITCHES

- A. Provide automatic slave transfer switches where indicated on the drawings for transfer of dimmer branch circuits utilized for emergency lighting.

END OF SECTION 26 32 13

SECTION 26 43 00 - SURGE PROTECTION DEVICES (SPDs) FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Section 16400 – Surge Protection Devices, individually mounted and switchboard mounted. Switchboards: Surge Protection Device integrated in switchboards.

1.3 REFERENCES

- A. IEEE C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits,
- B. IEEE C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits,
- C. IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
- D. National Electrical Code: Article 285
- E. UL 1283 - Electromagnetic Interference Filters
- F. UL 1449, Third Edition, effective September 29, 2009 – Surge Protection Devices

1.4 SUBMITTALS

- A. Product Data: Submit capacity, dimensions, weights, details, and wiring configuration.
- B. Submittals shall include UL 1449 3rd Edition Listing documentation verifiable by visiting www.UL.com, clicking “Certifications” link, searching using UL Category Code: VZCA and VZCA2:
 - 1. Short Circuit Current Rating (SCCR)
 - 2. Voltage Protection Ratings (VPRs) for all modes
 - 3. Maximum Continuous Operating Voltage rating (MCOV)
 - 4. I-nominal rating (I-n)
 - 5. SPD shall be UL listed and labeled as Type 1 or Type 4 intended for Type 1 or Type 2 applications.

- C. Upon request, an unencapsulated but complete SPD formally known as TVSS shall be presented for visual inspection.
- D. Minimum of ten (10) year warranty Manufacturer's Installation Instructions: Submit installation instructions and connection requirements.

1.5 QUALITY ASSURANCE

- A. List individual units under UL 1449 (Third Addition) and UL 1283.
- B. Single manufacturer: All equipment of each type shall be the product of one manufacturer.
- C. SPD shall comply with NEC Article 285 and shall be permanently marked with the short-circuit current rating of the device.
- D. Manufacturer Qualifications: Engage a firm with at least 5 years experience in manufacturing transient voltage surge suppressors.
- E. Manufacturer shall be ISO 9001 or 9002 certified.
- F. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- G. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept equipment on site in factory packaging. Inspect for damage.
- B. Protect equipment from damage by providing temporary covers until construction is complete in adjacent space.
- C. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manuals. One (1) copy of this document to be provided with the equipment at time of shipment.

PART 2 - PRODUCTS

2.1 SURGE PROTECTION DEVICES (SPDs)

- A. Manufacturers:
 - 1. Current Technology

2. Liebert
 3. Siemens
 4. Square D
 5. GE
- B. Product Description: Surge protection devices for protection of AC electrical circuits.
- C. Unit Operating Voltage: As indicated on Drawings.
- D. Construction:
1. Finish: Factory finish of baked enamel.
 2. Balanced Suppression Platform: Equally distribute surge current to Metal Oxide Varistor (MOV) components to ensure equal stressing and maximum performance. Furnish surge suppression platform with equal impedance paths to each matched MOV.
 3. Internal Connections: Hardwired with connections using low impedance conductors and compression fittings.
 4. Safety and Diagnostic Monitoring: Equipped with standard overcurrent protection:
 - a. Continuous monitoring of fusing system.
 - b. Monitor individual MOV's (including neutral to ground). Capable of identifying open circuit failures not monitored by conventional fusing systems.
 - c. Monitor for overheating in each mode due to thermal runaway.
 - d. Furnish green and red solid state indicator light on each phase. Absence of green light and presence of red light indicates which phases have been damaged. Fault detection activates flashing trouble light. Units not capable of detecting open circuit damage, thermal conditions, and over current will not be accepted.
 5. Labeling: Permanently affix UL 1449 (Third Addition) suppression voltage ratings and CSA to unit.
- E. Types:
1. Switchboards; locate as integral part of switchboard, coordinate mounting with switchboard manufacturer.
 2. Panelboards; locate as stand-alone. Component in housing adjacent to protected panelboard.
- F. Protection Modes: For Wye configured system, furnish device with directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For Delta configured system, furnish device with suppression elements between line to line (L-L) and line to ground (L-G).
- G. Switchboards:
1. The SPD shall be UL 1449 labeled as Type 1 or as Type 4 intended for Type 1 or Type 2 applications.
 2. SPD shall meet or exceed the following criteria:
 - a. Maximum 7-Mode surge current capability shall be 300kA per phase.
 - b. UL 1449 - Third Edition Revision; effective September 29, 2009, Voltage Protection Ratings shall not exceed the following:

	VOLTAGE	L-N	L-G	N-G	L-L	MCOV
	208Y/120	800V	800V	800V	1200V	150V
	480Y/277	1200V	1200V	1200V	2000V	320V

3. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/347	15%	320V

4. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of - 50dB at 100 kHz.
5. Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.
6. SPD shall include a serviceable, replaceable module.
7. SPD shall be equipped with the following diagnostics:
 - a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
 - b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
 - c. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.
 - d. Surge Counter

No other test equipment shall be required for SPD monitoring or testing before or after installation.
8. SPD shall have a response time no greater than 1/2 nanosecond.
9. SPD shall have a 10 year warranty.

H. Distribution and Lighting Panelboards:

1. Listing requirements: SPD shall bear the UL Mark and shall be Listed to most recent editions of UL 1449 and UL 1283. "Manufactured in accordance with" is not equivalent to UL listing and does not meet the intent of this specification.
2. Listing requirements: SPD and performance parameters shall be posted at www.UL.com under Category Code: VZCA. Products or parameters without posting at UL.com shall not be approved. (To access UL Category Code click on Certifications in the left menu bar of UL's home page. Type "VZCA" into the Category Code search box and click Search.)
3. SPD shall be UL 1449 labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.6.
4. SPD shall be UL 1449 labeled as Type 1 intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
5. SPD shall be UL 1449 labeled with 20kA I-nominal (I-n) (verifiable at UL.com) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.
6. Standard 7 Mode Protection paths: SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems

- 7. If a dedicated breaker for the SPD is not provided in the switchboard, the service entrance SPD shall include an integral UL Recognized disconnect switch. A dedicated breaker shall serve as a means of disconnect for distribution SPD's.
- 8. SPD shall meet or exceed the following criteria:
- 9. Minimum surge current capability (single pulse rated) per phase shall be:
 - a. Distribution applications:
 - 1) Siemens Model TPS3 09 with Maximum surge current capability of 100kA per phase

- 10. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

VOLTAGE	L-N	L-G	N-G
208Y/120V	700V	700V	700V
480Y/277V	1500V	1500V	1500V

UL 1449 Listed Maximum Continuous Operating Voltage (MCOV) (verifiable at UL.com):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/277V	20%	320V

- 11. SPD shall include a serviceable, replaceable module (excluding Distribution). (Deletable note: Delete or adjust as appropriate.)
- 12. Service Entrance SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.
- 13. SPD shall have a warranty for a period of ten (10) years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period.
- 14. SPDs shall be equipped with the following diagnostics:
 - a. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
 - b. Audible alarm with on/off silence function and diagnostic test function (excluding branch).
 - c. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.
 - d. Surge Counter

No other test equipment shall be required for SPD monitoring or testing before or after

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify mounting area is ready for equipment.
- B. Verify circuit rough-ins are at correct location.

3.2 INSTALLATION

- A. Install in accordance with IEEE 1100.
- B. Install service entrance suppressors in switchboard.
- C. Install suppressors for panelboards adjacent to panel.
- D. Install surge counter in face of switchboard.
- E. Include surge counter for stand-alone SPD.
- F. Install with maximum conductor length of 24 inches. Install suppressor with internal fusing.
- G. Provide 30 amp, 3 pole circuit breaker in panelboards to feed SPD.

END OF SECTION 26 43 00

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes interior luminaires, lamps, ballasts, and accessories. Provide all luminaries complete with all new lamps, completely wired, controlled, and securely attached to supports.

1.3 SUBMITTALS

- A. Product Data: Submit dimensions, ratings, and performance data.
- B. Photometric data for each luminaire, lamp and ballast. Include indications of all options and accessories as well as finish color.
- C. Specification Review: A complete item by item, line by line specification review.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Provide luminaires listed by U.L.
 - 2. Luminaires installed in outdoor areas unprotected from weather to be U.L. Listed for wet locations.
 - 3. Insulated ceilings: Luminaires installed into insulated ceilings shall be U.L. Listed Type IC.
- B. Certification: Certify that fixtures submittal have trim compatible with ceilings being installed.
- C. Concrete for outdoor lighting poles foundations shall be provided per Section 03 30 00 - Concrete.

1.5 EXTRA MATERIALS

- A. Provide extra materials for Owners use. All parts shall packaged in suitable carton.
- B. Provide ten (10) percent spare lamps of each lamp type. Deliver to Owner in original packaging.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. Product Description: Complete luminaire assemblies, with features, options, and accessories as scheduled.
- B. All luminaires shall be new and of specification grade.
- C. Manufacturer nomenclature in fixture schedule or otherwise described on the Drawings is given only to show the general fixture series. Contractor shall provide fixture with all required accessories and mounting frame type.
- D. Wire guard at fixtures in mechanical, electrical, and high abuse areas.
- E. Acceptable Manufacturers:
 - 1. Lightolier
 - 2. Lithonia
 - 3. Metalux
 - 4. Day-Brite
 - 5. Columbia
 - 6. HE Williams

2.2 LED LUMINAIRES

- A. Quality Assurance
 - 1. DOE Lighting Facts certified.
- B. LED Specifications
 - 1. Lumen maintenance of the LEDs has been tested in accordance with IESNA LM-80-08 reporting methodology.
 - 2. CRI: >82 minimum (general); >90 healthcare and retail.
 - 3. SDCM: <2.5 in linear pendants and linear recessed; <3.5 in discrete recessed.
 - 4. R9: .0 (general office/school environments); >50 in healthcare and retail environments.
 - 5. Outdoor luminaires to be rated at a minimum of 40° C.
- C. Lumen Maintenance
 - 1. Minimum L70 at 50K hours based on TM-21 Addendum A Lifetime report at an ambient temperature of 25° C, outdoors at an ambient temperature of 40° C.
- D. Thermal Testing
 - 1. ISTM testing in accordance to UL 1598-2008.
- E. Driver
 - 1. 0-10V enabled.
 - 2. Output Class 2 rated.
 - 3. Dimming range: 5-100%.
 - 4. Constant current.
 - 5. THD @ max load: <20%.
 - 6. Power factor: >0.95
 - 7. Environment protection rating: UL Damp and dry.

8. Approbations: certified to UL8750, UL1310, UL935, CSA-C22.2 No. 250.13-12, CSA 22.2 No. 223.
 9. ROHS Compliant
- F. Fixture photometry
1. Conducted by a NVLAP accredited testing lab with IESNA LM 79-08.
 2. System flux measured in delivered lumens.
- G. Warranty
1. 5 year total system warranty.

2.3 EMERGENCY BATTERY PACKS

- A. Provide Emergi-Lite FPSIU series, or approved equal, battery pack for fluorescent fixtures designated to have emergency battery back-up.
- B. Fixture shall include lighted push button test switch installed in visible, accessible location adjacent to fixture.
- C. Provide unswitched alternating current power source per manufacturer's instructions.
- D. Provide connection to local switch where indicated on drawings, connect such that fixture can be controlled on/off from local switch without discharge of battery.
- E. For fixtures designated to have emergency battery pack and be on a contactor controlled circuit, provide unswitched alternating current source ahead of contactor and wiring as required to allow automatic on/off control from the contactor without discharge of battery and local on/off switching where indicated.
- F. Battery pack shall provide 1100 lumen output for 90 minutes per 2'x4' light fixture.
- G. Provide integral battery pack for all exit signs where emergency generator power is not available. Battery pack shall provide minimum of 90 minutes output.

2.4 DOWNLIGHT FIXTURES

- A. Provide recessed light fixtures with trim rings compatible with the ceiling material where fixture is to be installed.

2.5 EXIT SIGNS

- A. Exit signs shall meet visibility requirements and be listed per UL 924 "Emergency Lighting and Power Equipment". Also shall meet Federal, State and Local Codes.
- B. Chevron Directional Indicator: Provide Chevron per NFPA 101 Section 5-10.4.1.2.
- C. Product Description:
 1. LED Exit Sign:
 - a. Provide exit sign with Light Emitting Diodes (LED) illuminance source. Cover LED with diffuser.

- D. Housing: Diecast aluminum with stencil face and matte white paint finish.
- E. Input Voltage: 120/277 volt, dual input voltage.
- F. EPA Energy Star Label.
- G. Wire Guards: Install wire guard on all exit signs installed in gyms, lockers rooms, and athletic wing.

2.6 OUTDOOR LUMINAIRE POLE ASSEMBLIES

- A. Outdoor Pole assemblies shall consist of a pole base, pole, luminaire or group and lighting circuit wiring.
- B. Diesel Standard: 2000 (IBC) International Building Code. Section 1609 requires wind forces on structure to be determined by the provisions of ASCE 7.
- C. Minimum Wind Speed: 120 miles per hour.
- D. Metal poles shall comply with NEC 410-15(b).
- E. Pole Material: Steel.
- F. Pole Shape: Round tapered.
- G. Pole finish shall match luminaires along mounting arms and bolt covers. Provide polyester powder coat finish on pole and luminaire, 3 mil thick.
- H. Pole accessories to include handhole and cover, full matching anchor bolt cover, anchor bolt kit, template, washers and leveling nuts. Contractor silicone the pole base covers to the top of the concrete base, leave 1/2" gap in silicone in center of each side for water to drain.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned luminaires, lamps, poles and accessories.
- B. Extend existing luminaire installation using materials and methods compatible with existing installation, or as specified.
- C. Clean and repair existing luminaires to remain or to be reinstalled.

3.2 INSTALLATION

- A. General: All luminaires shall have proper supports.
- B. Install suspended luminaires using pendants supported from swivel hangers.
- C. Locate recessed ceiling luminaires as indicated on Drawings.

- D. Install surface mounted ceiling luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Chain Hung: Unless otherwise indicated all fluorescent fixtures in Mechanical, Electrical and Elevator Equipment Rooms shall be chain hung. Verify exact mounting height with Architect before installing fixtures. Provide pendant hangers when equipment room has fire-resistive ceiling.
- F. Suspended Ceilings:
 - 1. Provide means of support for luminaires per NEC 410-36. T-bar clips shall be installed on the luminaire and shall be field secured to the inverted ceiling tees so that the luminaire is securely fastened to the ceiling system framing members.
 - 2. Ceiling tiles shall not bear the weight of luminaires. Surface mount luminaires, recessed downlights, light track, exit signs, etc. shall be supported by proper frames or other attachment to main ceiling system grid or building structure above ceiling.
 - 3. Luminaires shall be centered in ceiling tile.
 - 4. Luminaire shall have flange or trim ring for closure of ceiling cutout or opening.
 - 5. Fire-rated Ceiling Assembly: For Luminaires to be flush-mounted into a fire-rated ceiling or surface mounted to a fire-rated ceiling, install with independent, secure support. Raceway, cable assemblies, boxes and fittings located above a fire-rated floor/ceiling or roof ceiling assembly shall not be secured to, or supported by, the ceiling assembly including the ceiling support wires. Provide an independent means of secure support. Independent support wires shall be distinguishable by color, tagging, or other effective means from those that are part of the fire-rated design.
- G. Verify weights and recommended mounting methods of all luminaires with manufacturers. Furnish and install supports. Luminaires weighing more than 30 pounds shall be supported independently of the outlet box.

3.3 LOCATIONS

- A. Luminaires shown on the Electrical Drawings represent general arrangements only. Refer to Architectural Drawings and to Architect on jobsite for more exact locations. Coordinate location with all other trades before installation. Coordinate all light fixtures in Mechanical Rooms with the final installed piping and ductwork layouts. Adjust fixture mounting height and location if required so that light output is not obstructed by piping and ductwork.

3.4 FIRE INTEGRITY OF CEILING PENETRATIONS

- A. Where ceiling is part of a fire-rated assembly, maintain integrity of that assembly with methods given in Section Electrical Hangers and Supports. Obtain ceiling system UL Fire Resistance Directory Design Number from Architectural Drawings.

3.5 AIMING AND ADJUSTMENT

- A. General: All adjustable lighting units shall be aimed, focused, and locked by the Contractor under the supervision of the Architect/Owner. All aiming and adjusting shall be carried out after the entire installation is complete.

3.6 LAMPS

- A. Clean all lamps after installation.

3.7 CLEANING

- A. Lens: Clean lenses of all luminaires after space is finished and prior to project acceptance.
- B. Louvers: Remove plastic bag from parabolic louver luminaires after space is finished and prior to project acceptance. Do not remove bags until luminaires have been cleared by the air-balance subcontractor.

3.8 OUTDOOR LUMINAIRE POLES

- A. Pole Base: Do not grout space between pole base plate and top of concrete pole foundation. Leave open to allow water to drain and for pole to breathe. If grout is recommended by pole manufacture in space between pole base plate and top of concrete pole foundation, provide grout with drain hole through grouting.
- B. Pole Delivery: Unwrap pole upon delivery to job site, unless otherwise instructed by pole manufacturer. Wrapped poles exposed to weather that show wrapper striping or other deterioration of finish shall be replaced at Contractor expense. Replacement shall be new pole or pole refinished at pole factory.
- C. Installation:
 - 1. Poles shall be erected only with luminaire(s) or equivalent damping device, unless otherwise instructed by pole or luminaire manufacturer. Poles installed without luminaires are subject to increased modes of vibration.
 - 2. Do not level pole with shims; leveling nuts above and below pole baseplate provide flexible adjustment and long-term holding of pole position.
 - 3. Provide anchor bolts and pole manufacturer's bolt template prior to concrete formwork for pole bases.
 - 4. Minimum wire size for circuit tap inside pole shall be AWG #12.
 - 5. Install pole base cover. Cover shall rest on top of concrete pole foundation and completely conceal air space under pole base plate.
- D. Fusing:
 - 1. Install fuse holder and fuses as noted in pole base detail on Drawings.
 - 2. All ballast-controlled luminaires shall be protected by Bussmann Fuses FNQ with Holders HEB (1-pole) or (2-pole) HEX. Fuse(s) and holder shall be mounted inside pole at handhole. Size of fuse to be recommended by the luminaire manufacturer.

3.9 RFI

- A. Provide flexible braided metal electrical bonding strap from grounded housing to door frame of all fluorescent parabolic fixtures in designated rooms. Bonding strap shall be braided conductor designed for field installation to either long door side.

END OF SECTION 26 50 00

SECTION 27 00 00 - BASIC MATERIALS AND METHODS

PART 1 – GENERAL

1.01 RELATED WORK

- A. The entire drawing and specification package apply to the work specified in the telecommunications sections of the specifications and shall be complied with in every respect. The Contract Documents are comprised of the drawings and specifications. The Contractor shall examine these Contract Documents, and coordinate required work indicated in each.

1.02 SCOPE OF WORK

- A. The work covered by the specifications includes furnishing materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary for the complete installation of work required in the Contract Drawings.
- B. It is the intent of the Contract Documents to provide an extension of the existing installed systems interfaced with new systems, complete in every respect.
- C. The Contractor shall be responsible for coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with the existing site conditions, details of the work and the working conditions, and verify dimensions in the field. The Contractor shall advise the Engineer of any discrepancy prior to bidding. The submission of bids shall be deemed evidence of the Contractor's site visit; coordination of existing conditions and include consideration for existing conditions.
- D. Provide line-by-line specification review for each Division 27 section annotated to certify compliance or deviation.

1.03 DRAWINGS AND SPECIFICATIONS

- A. The drawings and these specifications are complementary to each other, and what is required by one shall be as binding as if required by both.
- B. If variations or departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Engineer for review. No departures shall be made without prior written acceptance of the Engineer.
- C. Should the drawings or specifications disagree in themselves or with their counterpart, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Engineer in writing, shall be performed or furnished. In case the specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on drawings govern scale measurements and large scale details govern small scale drawings.
- D. Items specifically mentioned in the specifications but not shown on the drawings and/or items shown on the drawings but not specifically mentioned in the specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

1.04 CODES AND STANDARDS

- A. All work shall comply with the applicable articles of the National Electrical Code, the National Electrical Safety Code, the National Fire Codes (published by National Fire Protection Association), and City Codes and Ordinances, as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provisions of this specification shall be construed as waiving any of the rules, regulations, or requirements of these authorities.
- B. Contractor is responsible for knowledge and application of current versions of all applicable standards and codes. In cases where listed standards and codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.
- C. ANSI/TIA:
1. ANSI/TIA-526-7-A (July 2015) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
 2. TIA-526.2-A (July 2015) Effective Transmitter Output Power Coupled into Single-Mode Fiber Optic Cable - Adoption of IEC 61280-1-1 ed. 2 Part 1-1: Test Procedures for General Communication Subsystems – Transmitter Output Optical Power Measurement for Single-Mode Optical Fiber Cable
 3. ANSI/TIA-4994 (March 2015) Standard for Sustainable Information Communications Technology
 4. ANSI/TIA-526-14-C (April 2015) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
 5. ANSI/TIA-568.0-D (September 2015) Generic B (supersedes TIA-568-C.0 and TIA-568-C-1)
 6. ANSI/TIA-568.1-D (September 2015) Commercial Building Telecommunications Infrastructure Standard (supersedes ANSI/TIA-C.1)ANSI/TIA-568.2-D (September 2018) Balanced Twisted-Pair Telecommunications Cabling and Components Standard
 7. ANSI/TIA-568.3-D (June 2016) Optical Fiber Cabling Components Standard
 8. ANSI/TIA-568.4-D (August 2020) Broadband Coaxial Cabling Components Standard
 9. ANSI/TIA-569-E (May 2019) Telecommunications Pathways and Spaces
 10. ANSI/TIA-598-D (July 2014) Optical Fiber Cable Color Coding
 11. ANSI/TIA-570-C (August 2012) Residential Telecommunications Infrastructure Standard
 12. ANSI/TIA-606-C (June 2017) Administration Standard for Telecommunications Infrastructure
 13. ANSI/TIA-607-D (July 2019) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
 14. ANSI/TIA-758-B (March 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
 15. ANSI/TIA-862-B (February 2016) Structured Cabling Infrastructure Standard for Intelligent Building Systems
 16. ANSI/TIA-942-B (July 2017) Telecommunications Infrastructure Standard for Data Centers
 17. ANSI/TIA-1005-A (May 2012) Telecommunications Infrastructure Standard for Industrial Premises
 18. ANSI/TIA-1005-A-1 (January 2015) Telecommunications Infrastructure Standard for Industrial Premises, Addendum 1- M12-8 X-Coding Connector - Addendum to TIA-1005-A
 19. ANSI/TIA-1183 (August 2012) Measurement Methods and Test Fixtures for Balun-

- Less Measurements of Balanced Components and Systems
20. ANSI/TIA-1183-1 (January 2016) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems, Extending Frequency Capabilities to 2 GHz - Addendum to TIA-1183
 21. TIA-1152 (November 2016) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
 22. TIA-1179-A (September 2017) Healthcare Facility Telecommunications Infrastructure Standard
 23. ANSI/TIA-4966 (May 2014) Telecommunications Infrastructure Standard for Educational Facilities
 24. TIA-455-104-B (February 2016) FOTP 104- Fiber Optic Cable Cyclic Flexing Test (supersedes TIA-455-104-A)
 25. TIA/EIA-455-25-D (February 2016) FOTP-25 Impact Testing of Optical Fiber Cables
 26. TIA-604-18 (November 2015) FOCIS 18 Fiber Optic Connector Intermateability Standard – Type MPO-16
 27. TIA-604-5-E (November 2015) FOCIS 5 Fiber Optic Connector Intermateability Standard-Type MPO
 28. TIA-5017 (March 2016) Telecommunications Physical Network Security Standard
 29. TIA-TSB-155-A (Reaffirmed 10-6-2014) Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
 30. TSB-184 (July 2009) Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
 31. TSB-4979 (August 2013) Practical Considerations for Implementation of Multimode Launch Conditions in the Field
 32. TSB-190 (June 2011) Guidelines on Shared Pathways and Shared Sheaths
 33. TIA-TSB-162-A (November 2013) Telecommunications Cabling Guidelines for Wireless Access Points
 34. TSB-5018 (July 2016) Structured Cabling Infrastructure Guidelines to support Distributed Antenna Systems
 35. TIA-492AAAE (June 2016) Detail Specification for 50- μ m Core Diameter/125- μ m Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers with Laser-Optimized Bandwidth Characteristics Specified for Wavelength Division Multiplexing
 36. TIA-492AAAB-A (November 2009) Detail specification for 50- μ m core diameter/125- μ m cladding diameter class 1a graded-index multimode optical fibers
 37. TIA-455-243 (March 2010) FOTP-243 Polarization-mode Dispersion Measurement for Installed Single-mode Optical Fibers by Wavelength-scanning OTDR and States-of-Polarization Analysis
 38. TSB-172-A (February 2013) Higher Data Rate Multimode Fiber Transmission Techniques
- D. ISO/IEC:
1. ISO/IEC TR 11801-99-01 Information technology – Generic cabling for customer premises: Guidance for balanced cabling in support of at least 40 GBit/s data transmission: Parts 1 and 2
 2. ISO/IEC TR 29106 AMD 1 Information technology -- Generic cabling -- Introduction to the MICE environmental classification
 3. ISO/IEC 24764 AMD 1 Information technology – Generic cabling for data centers
 4. ISO/IEC 11801 AMD 1 AMD 2 Information technology – Generic cabling for customer premises
 5. ISO/IEC 15018 AMD 1 Information technology – Generic cabling for homes
 6. ISO/IEC 24702 AMD 1 Information technology – Generic cabling – Industrial premises
 7. ISO/IEC 14763-1 AMD 1 Information technology – Implementation and operation of customer premises cabling – Part 1: Administration

8. ISO/IEC 14763-2 Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation
 9. ISO/IEC 14763-2-1 Information technology – Implementation and operation of customer premises cabling – Part 2-1: Planning and installation – Identifiers within administration systems
 10. ISO/IEC 14763-3 Ed 2.0 Information technology -- Implementation and operation of customer premises cabling -- Part 3: Testing of optical fiber cabling
 11. ISO/IEC TR 24704 Information technology – Customer premises cabling for wireless access points
 12. ISO/IEC TR 24750 Information technology – Assessment and mitigation of installed balanced cabling channels in order to support 10GBASE-T
 13. ISO/IEC TR 29125 IT Telecommunications cabling requirements for remote powering of terminal equipment
- E. BICSI – Building Industry Consultative Services International – Published Standards
1. ANSI/BICSI 001-2009, Information Transport Systems Design Standard for K-12 Educational Institutions
 2. ANSI/BICSI 002-2014, Data Center Design and Implementation Best Practices
 3. ANSI/BICSI-003-2014 Building Information Modeling (BIM) Practices for Information Technology Systems
 4. BICSI 004-2012, Information Technology Division Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
 5. ANSI/BICSI 005-2016, Electronic Safety and Security (ESS) System Design and Implementation Best Practices
 6. BICSI 006-2015 Distributed Antenna System (DAS) Design and Implementation Best Practices
 7. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
 8. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
 9. BICSI – Building Industry Consultative Services International – Manuals
 10. Telecommunications Distribution Methods Manual, 14th Edition (2020)
 11. Information Transport Systems Installation Methods Manual (ITSIMM), 6th Edition
 12. Outside Plant Design Reference Manual, 5th Edition
 13. BICSI's ICT Terminology Handbook, Version 1.0
 14. Telecommunications Project Management Manual (TPMM), 1st edition
 15. Telecommunications Project Management Reference Document (TPMRD), 2nd Edition
 16. BICSI's Special ICT Design Considerations, Version 1.0
 17. Essentials of Bonding and Grounding, Version 1.0
- F. National Electric Codes
1. National Electrical Safety Code (NEC) (IEEE C2-2012)
 2. NFPA 70-2020, National Electrical Code® (NEC®)
 3. ANSI/IEEE C2-207, National Electrical Safety Code®
 4. National Electrical Code (NEC) (NFPA 70)
 5. NFPA 72 National Fire Alarm and Signaling Code
- G. ASHRAE
1. ASHRAE Standard 90.4P, Energy Standard for Data Centers and Telecommunications Buildings
- H. OSHA Standards and Regulations – all applicable

- I. Local Codes and Standards – all applicable
- J. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.
- K. Knowledge and execution of applicable standards and codes is the sole responsibility of the Contractor.
- L. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense.
- M. In any instance where these Specifications call for materials for construction of a better quality or larger size than required by the codes, the provisions of these Specifications shall take precedence. The codes shall govern in case of direct conflict between the Codes and the Drawings.

1.05 EXISTING UTILITIES

- A. The Contract Documents reflect the general location and routing for all telecommunications services known to exist on this project.

1.06 BUILDING CONSTRUCTION AND LAYOUT OF WORK

- A. General: It shall be the responsibility of the Contractor to consult the Engineering Drawings and Details so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.
- B. The drawings are diagrammatic in nature and do not show every connection in detail or every line or conduit in its exact location. These details are subject to the requirements of all codes and ordinances as well as all structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be laid out so that it will be concealed in furred chases unless specifically noted or indicated to be exposed. Work shall be installed to avoid crippling of structural members; therefore, inserts to accommodate conduit hangers shall be set before concrete is poured, and proper openings through floors, walls, beams, etc. shall be provided as hereinafter specified or as otherwise indicated or required before concrete is poured. All work shall be run parallel or perpendicular to the lines of the building unless otherwise noted.
- C. The approximate location of equipment items is indicated on the drawings. Exact locations are to be determined by coordination of dimensions from approved equipment submittals and site-verified field measurements and will in all cases be subject to the approval of the Engineer. The Engineer reserves the right to make any reasonable changes in the indicated locations prior to installation for no additional cost.
- D. In areas of existing special ceiling construction the removal and restoration must be carefully planned such that the existing condition of the ceilings is maintained. It may be necessary for the Contractor to procure a Subcontractor familiar with this work to achieve this requirement.

PART 2 – PRODUCTS

2.01 GENERAL MATERIALS AND EQUIPMENT REQUIREMENTS

- A. Materials, in general, shall conform to the National Electrical Code requirements and shall be listed, inspected, and approved by the Underwriters Laboratories and shall bear the UL label where labeling service is available. The label or listing of the Underwriters Laboratories, Inc. will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this listing, the Contractor may submit a statement from a nationally recognized, adequately equipped testing agency, indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all Contract requirements.

2.02 STANDARD PRODUCTS

- A. Materials and equipment shall be the standard catalog products of manufacturers regularly engaged in the manufacture of products conforming to these specifications, and shall essentially duplicate materials and equipment that have been in satisfactory use at least two (2) years prior to bid opening. Where custom or special items are required, these shall be fully described using drawings, material lists, etc., which fully describe in detail the item proposed for use on this project.

2.03 MANUFACTURER'S INSTRUCTIONS

- A. The Contractor is responsible for furnishing the proper telecommunications equipment and/or material and for seeing it is installed as intended by the manufacturer. The Contractor shall, wherever necessary, request advice and supervisory assistance from equipment manufacturers as required for the proper installation, operation, or start-up. The Contractor shall notify the Engineer in writing of any conflict between the Contract Documents and the manufacturer's recommendations and shall obtain from the Engineer instructions/direction before proceeding with the work. The Contractor shall pay for all costs resulting from deficiencies created by installation not in accordance with the manufacturer's recommendations or the instructions of the Engineer.

2.04 RUST PREVENTION

- A. Metallic materials shall be protected against corrosion. Exposed metallic parts of equipment exposed to the elements shall be given a rust inhibiting treatment and standard finish by the manufacturer. Components such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected in accordance with the ASTM A123 or A153, except where other equivalent protective treatment is specifically approved in writing.

2.05 STORAGE AT SITE

- A. The Contractor shall not receive material or equipment at the job site until ready for installation or until there is suitable space provided to properly protect equipment from rust, weather, humidity, dust, or physical damage.

2.06 CONDITION OF MATERIALS

- A. All materials required for the installation of the telecommunications systems shall be new and unused. Any material or equipment damaged in transit from the factory, during

delivery to premises, while in storage on premises, while being erected and installed, or while being tested, until time of final acceptance, shall be replaced by this Contractor without extra cost to Owner.

2.07 NAMEPLATES

- A. Factory assembled components and equipment shall be provided with embossed nameplates, securely attached to the equipment with rivets or screws. Nameplates will have information required to specifically identify the equipment in the future such as the manufacturer's name, address, catalog number, serial number, etc. All data on nameplates shall be legible at the time of final inspection.

PART 3 – EXECUTION

3.01 ACCEPTABLE MANUFACTURERS

- A. The specifications contain the names of manufacturers which are considered acceptable based on the quality of the product.
- B. Where acceptable manufacturers are listed, only products of those manufacturers may be provided. Additionally, the product must meet all the detailed requirements of the specifications.
- C. If no manufacturer's name is mentioned, the Contractor shall provide equipment and material which meet the specifications.
- D. The drawings represent the manufacturer's equipment scheduled. The listing of acceptable manufacturers in the specifications is not intended to imply that equipment of these other manufacturers will fit in the space provided or have the same electrical, structural or other requirements as the equipment scheduled. The Contractor must ensure that the equipment provided will meet all project requirements prior to submitting data on that equipment.

3.02 SPACE AND EQUIPMENT ARRANGEMENT

- A. Equipment and components shall be installed in a manner to permit access to parts requiring service. Telecommunications equipment shall be installed in such a manner as to allow removal for service without disassembly of adjacent equipment.
- B. Large equipment or apparatus which is to be installed in the building, and which is too large to permit access through stairways, doorways, or shafts shall be brought to the job and placed in the space before the enclosing structure is completed. Following placement in the space, such apparatus shall be thoroughly protected from damage.
- C. Equipment shall have working clearances as required by applicable codes and standards.

3.03 SUBMITTAL AND REVIEW OF MATERIALS

- A. After the Contract is awarded, but prior to proceeding with the Work, the Contractor shall obtain, check, certify, and submit complete Shop Drawings and Brochures from Manufacturers, Suppliers, Vendors, etc., for all materials and equipment specified herein. Submit Shop Drawings and Brochures in sufficient time so as not to impede the progress of work. Three weeks will be required for the processing of Shop Drawings and Brochures in the Engineer's office, exclusive of transmittal time. This time shall be

considered by the Contractor when scheduling submittal data. After the Contract is awarded, the Contractor will advise the Engineer in writing of the schedule for submission of shop drawings and product data and the persons authorized to sign submittal data on behalf of the Company.

- B. The Engineer's review of Shop Drawings and Brochures shall not relieve the Contractor of the responsibility for dimensions, errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the Engineer's noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the submittal data review.
- C. Before submission of Shop Drawings and Brochures, the Contractor shall certify that each Shop Drawing and each item of material or equipment complies with the Contract Documents for this Project. Such certification shall be made by the Owner, a Partner, a Corporate Officer of the Contractor, or by a person duly authorized to sign for the Contractor. Unless so certified, Shop Drawings and/or Brochures will be returned for resubmittal. Certifications shall be in the form of rubber stamp impressions or typed letter which states:

I hereby certify that this Shop Drawing and/or brochure and the equipment and material shown on this Shop Drawing and/or Brochure complies in all aspects (except as noted*) with the requirements of the Contract Documents for this Project. I further certify that all data shown herein as to performance, dimensions, construction, materials, and other pertinent items are true and correct.

Name of Contractor _____

Signed _____

Position _____

Date _____

*Refer to exception requirements herein.

- D. Each Shop Drawing shall indicate in the lower right hand corner and each Brochure shall indicate on the front cover the following: Title of the Sheet or Brochure; name and location of the building; names of the Engineer, Contractor, Manufacturer, Supplier, Vendor, etc., the date of submittal; and the date of each correction and revision. So far as is practical, each Shop Drawing and/or Brochure shall bear a cross-reference note to the sheet number or numbers of the Contract Drawings and Specifications showing the same work. Shop Drawings and Brochures shall be prepared as follows:
 - 1. Shop Drawings: Drawings shall be newly prepared and not reproduced from the Contract Documents, drawn to a scale that can be easily read and shall contain sufficient plans, elevations, sections, and isometrics to describe clearly the items in question. Drawings shall be prepared by a draftsman skilled in this type of work. All equipment layouts and similar Shop Drawings shall be drawn to at least 1/4-inch = 1'-0" scale.
 - 2. All Shop Drawings shall indicate the equipment actually purchased. The elevation, location, support points, load imposed on the structure at support and anchor points,

- shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. All Design Drawing space allocations shall be maintained, such as ceiling height, chase walls, equipment room size, etc., unless proper written authorization is required from the Engineer to change them. All associated equipment shall be coordinated and clearly shown on the Shop Drawings.
3. Brochures: Brochures submitted to the Engineer shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information to show that the equipment will fit into the allotted space.
 4. Brochures submitted shall contain only information which is relevant to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless all irrelevant information is marked out or relevant information is clearly marked.
- E. The submittal format shall follow the Specifications format with a submittal required for each required section. The submittal shall be contained in a three-ring hard back binder. Copies of each submittal shall be three-hole punched and arranged (or folded if required) for the Engineer's filing convenience. Provide one copy of updated TABLE OF CONTENTS and progressive-tabbed index sheets also for the Engineer's filing convenience.
 - F. Submittal data for each section must be complete. Partial submittals will not be reviewed. To the greatest extent possible all sections shall be submitted with the first submission. No more than three additional submissions will be allowed to complete the submittal package.
 - G. Unless a greater number is indicated within Division One of these specifications, submit six (6) copies of all Brochures for review. Submit one (1) reproducible and one (1) blueprint of shop drawings for review. Comments will be made on the reproducible to facilitate copying.
 - H. Any submittal that is disapproved must be resubmitted within two (2) weeks following notification of such disapproval. If no satisfactory material is submitted within the two-week period, the Engineer reserves the right to require the Contractor to furnish items exactly as described in the Contract Documents.
 - I. No allowances will be made for submittals which are not made in a timely fashion or which are turned down because they do not meet the specifications. Should delivery problems arise due to the above, affecting the completion time of the project, the Contractor will furnish and install acceptable alternates until the proper materials arrive and then replace the alternate materials with the approved materials, all at no cost to the Owner. If the Contractor is not able to furnish an acceptable alternate until the proper materials arrive, he will assume all costs for furnishing and installing all alternates as directed by the Engineer and/or will pay a suitable penalty for the inconvenience experienced by the Owner. This penalty will be set by the Owner based on the particular circumstances.

3.04 SUPERVISION

- A. A competent certified foreman or superintendent, approved by the Engineer, shall be maintained at the project site to receive instructions and to act for the Contractor. Once this superintendent has been approved, no change shall be made without approval of the Owner or his authorized representative. The Owner and his authorized representative shall have the right to observe the work at any time. The Contractor shall have a representative present when his work is being observed, and he shall give assistance as

required.

3.05 CUTTING AND PATCHING

- A. Where it is necessary to cut through walls, floors, or ceilings to permit installation of work under this section of the Contract, or to repair any defects that may appear, up to the expiration of guarantee period, such cutting shall be done under the supervision of the Engineer. The Contractor shall not be permitted to cut or modify any structural members without the written permission of the Engineer.
- B. Patching of all openings and repairing of any damage to the work of other trades occasioned by cutting operations, or occasioned by the failure of any part of work installed under this Contract, shall be performed by the trade whose work is involved, and shall be paid for by the Contractor.
- C. Openings cut through exterior walls or roofs shall be provided with suitable covers to protect the property or materials involved. Openings cut through walls below grade shall be properly protected to prevent entrance of water or other foreign elements. Openings cut between fire zones or plenums shall be sealed to maintain the fire integrity of the wall or floor. Conduits and cable tray through plenum wall shall be sealed using materials complying with UL 1479, NEC 300-21, and NEC 800-3(C), and shall be UL classified.

3.06 HOISTING, SCAFFOLDING, AND TRANSPORTATION

- A. Provide hoisting and scaffolding facilities as required to set materials and equipment in place.

3.07 CLEANING

- A. The Contractor shall at all times keep the premises free from accumulations of waste material or rubbish. Debris shall be removed from the site and from any street or alley adjacent to the site.
- B. At completion of the project, the Contractor shall remove all tools, scaffolding, and surplus materials. Contractor shall leave the area "broom clean". Before final acceptance, vacuum all panels, cabinets, racks and other equipment enclosures. Wipe clean all fixture lenses and reflectors, all panelboard and switchboard interior and exterior surfaces, being careful to remove all stray paint, construction materials, dust, and particles. Touch-up all marred surfaces to restore existing conditions to those provided by the manufacturer.

3.08 CONDUIT SLEEVES

- A. Where conduits pass through walls or floors not on fill, galvanized sheet metal sleeves shall be provided and shall be sealed to prevent air and noise transmission. In walls, they shall be flush with each finished surface. In pipe chases, they shall extend 1-1/2 inches above floor slab and be cemented in a water tight manner. Size of these sleeves shall be at least 1/2 inch greater than outside diameter of the conduit.
- B. For conduits passing through outside walls, provide and install galvanized steel sleeves having an inside diameter at least 4 inches greater than the outside diameter of contained conduit. Where these occur in walls having a waterproof coating applied, the sleeves shall have welded flanges to build into waterproofing. When conduits are installed, the annular space between pipe and sleeve shall be effectively sealed, using shredded lead hammered

in place or an approved mastic sealer.

- C. Pipe and duct sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided for roof penetrations.

3.09 GROUNDING

- A. Ground buses shall be provided in each Telecommunications room by Division 16 Contractor unless noted on Contract Drawings.
- B. Telecommunications grounding system shall be a single point grounding from the building entrance electrical ground to each Telecommunications room. This Grounding system shall be provided by Division 16 Contractor unless notes on Contract Drawings.
- C. All Conduit systems, cabinets' racks, cable trays, protector blocks, SCTP patch panels and/or miscellaneous equipment, etc. shall be grounded by being connected to the common telecommunications grounding system. The conductors shall be a # 6awg solid with a green jacket

3.10 RECEDENCE OF WORK

- 1. This Contract includes many different systems furnished and installed by different trades. All trades shall coordinate their work with that of all other trades so that it may be installed in the most direct and workmanlike manner without hindering or handicapping other trades.

3.11 RECORD DRAWINGS

- A. The Contractor shall keep a set of Drawings on the job, noting daily all changes made in these Drawings in connection with the final installation, including exact dimensioned locations of all new and uncovered existing active and inactive utilities outside the building, and shall turn over a clean, neatly marked set of mylar reproducible Drawings showing "as-installed" work to the Engineer for delivery to the Owner. All underground utilities, services, and systems shall be accurately located by the Contractor and dimensioned on the "as-installed" Drawings.

3.12 OPERATING AND MAINTENANCE MANUAL

- A. The Contractor shall furnish indexed operating and maintenance manuals with complete technical data for each system, piece of equipment, and material installed under this Contract.
- B. Two (2) copies of the manual, bound in hardback binders or an approved equivalent, shall be provided. One copy shall be completed and delivered to the Engineer prior to the time that system and equipment tests are performed. The second copy shall be delivered prior to final acceptance.
 - 1. Provide one (1) operation and Maintenance manual for each building. Provide one (1) as-built floor plan and one CD for each building.
- C. The manual shall include the following information
 - 1. Manufacturer's installation instructions.
 - 2. Manufacturer's local representative and/or distributor's name and address.
 - 3. Manufacturer's operating and maintenance instructions.

4. Manufacturer's internal wiring diagrams.
 5. Contractor's installation wiring diagrams.
 6. Replacement part number listings and descriptions.
 7. Framed operating instructions, when required, in individual Specification sections.
 8. Warranties and guarantees.
 9. Provide an approved submittal at the front of each section.
- D. The manuals shall be identified on the cover as "Operating and Maintenance Manual" with additional cover display of the name and location of project, the Owner, the Engineers, the General Contractor, and the Subcontractors installing equipment represented in the brochure.
- E. The manual shall have a Table of Contents and shall be grouped in sections according to the sections of Division 27. Each section shall have a copy of the pages of the Specifications covered within the section. Sections shall be organized as follows:
1. Each section in the manual shall identify the grouping of all literature required for the system or equipment included.
 2. The contents of each section shall be arranged in the following sequence: First, the approved engineering submittals with complete performance and technical data; second, the manufacturer's installation brochure; third, the manufacturer's operating and maintenance brochure; fourth, the manufacturer's installation wiring diagram; fifth, the Contractor's field wiring diagram, if different; and sixth, the manufacturer's brochure listing replacement part numbers and description.
 3. Provide a final section entitled, "Warranties and Guarantees", for all equipment, etc.

3.13 EXISTING FACILITIES

1. The Contractor shall be responsible for loss or damage to the existing facilities and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices and receive written permission from the Owner to enter existing areas. Before beginning work in existing areas, the Contractor shall make necessary arrangements and perform other services required for the care, protection, and in-service maintenance of all electrical, communication, plumbing, heating, air condition, and ventilating services for new and existing facilities. The Contractor shall erect temporary barricades with necessary safety devices to protect personnel from injury, removing all such temporary protection upon completion of the work.
2. The Contractor shall provide temporary or new services to existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.
3. Where existing construction is removed to provide working and extension access to existing utilities, the Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air condition ductwork, and equipment, etc. to provide this access and shall reinstall same upon completion of work.
4. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed, the Contractor shall remove and reinstall in locations approved by the Engineer all devices required for the operation of the electrical systems installed in the existing construction. This is to include, but is not limited to, temperature control system devices, electrical switches, relays, fixtures, piping, conduit, etc.

3.14 DEMOLITION AND RELOCATION

1. The Contractor shall modify, remove, and relocate all materials and items so indicated on the drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain as directed by the Owner. Materials and items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to the approval of the Owner. The Contractor may substitute new materials and items of like design and quality in lieu of materials and items to be relocated, if approved by the Owner.
2. All items scheduled for relocation and/or reuse shall be inspected by the Contractor and the Owner or his authorized representative. A written report of the condition of each item shall be made and provided to the Engineer. Where items scheduled for relocation and/or reuse are considered unsuitable for reuse, the Contractor shall so notify the Engineer and await reinstallation instructions before proceeding with removal. Items damaged in reinstallation shall be repaired or replaced by the Contractor as directed by the Owner at not additional cost to the Owner or the Engineer.
3. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean, repair, and provide all new materials, fittings, and appurtenances required to complete the relocation and to restore the items to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.
4. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points as indicated on the drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied off or connections into the existing facilities in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific written approval of the Engineer.

3.15 OUTAGES

1. Outages of services as required by the project will be permitted, but only at a time approved by the Owner. The Contractor shall notify the Owner in writing two (2) weeks in advance of the requested outage in order to schedule required outages. No outages shall be taken unless written approval has first been received from the Owner. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the Contract amount.

END OF SECTION

SECTION 27 10 00 – STRUCTURED CABLING SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 1, as applicable, apply to this Section.

PART 1 – GENERAL

1.1 RELATED SECTIONS AND DOCUMENTS

- A. 27 41 16 – VIDEO WALL SYSTEMS
- B. Drawings that are applicable to this section

1.2 DESCRIPTION

- A. Summary of Work:

1. Provide a complete and tested, Structured Cabling System (SCS) for the interconnections of the Local Area Network (LAN). The SCS shall include fully terminated unshielded twisted pair cables, fiber optic cabling, raceways, conduit, back boxes, copper/fiber optic termination components, station mounting hardware, fiber optic enclosures, patch panels, copper/fiber optic patch cables, relay racks/cabinets, and other incidental and miscellaneous premises wiring system hardware as required for a complete, tested, and usable system that is in compliance with the latest NEC, ANSI/EIA/TIA, BICSI, and Authorities Having Jurisdiction codes and standards. The installation shall comply with all applicable requirements, design guidelines, and standards in effect at the job site and as indicated in the Drawings and Specifications.
2. Proposed structured cabling must support all current and future standards and data technology.
3. Data, voice, and video cabling will originate in vertical freestanding equipment racks, and/or enclosed vertical wall mounted equipment located in the MDF/IDF locations. Wiring, terminations and patch bays between these designated d-marc points and outlet locations as shown on the plans will be considered part of the contract.
4. All cables and termination will be labeled at all locations.
5. All cables will be labeled according to the College standard (at each location).
6. All copper data cabling will comply with ANSI/TIA/EIA/EIA 568-B standards for Category 6A installations.
7. Acceptable product manufacturers shall provide a complete Category 6A solution.
8. No cable ties, bridle rings, or d rings shall be accepted on the project. Any use of cable ties may require replacement of the entire project cabling at Contractor's expense.
9. Provide AV cabling as shown on the drawings.
10. Cabling will terminate on one, two, or three gang wall plates equipped as shown on the drawings.
11. Prior to installation, the shop drawings shall contain all data drop numbers using the College's MDF/IDF numbering scheme. The owner must sign off shop drawings before any cabling can proceed.
12. Project documentation due upon completion of installation. Documentation includes (but not limited to) all test documentation and all as-builds.
13. The owner reserves the right to be present during installation of all systems. The owner will conduct periodic inspections throughout the construction process.
14. Any loose inventory equipment turned over to the college will require a transmittal sheet when delivered.

15. Contractor will be required to furnish a list (in Excel format) of all data drops listed by IDF/MDF number, patch panel number, and port number with the associated College assigned room number. (Number scheme listed in Section 3.2 Documentation.)
16. Provide laminated as-built drawings (full sized sheet) for each IDF and provide an addendum as-built drawing (full-sized sheet) for the MDF.

1.3 QUALITY ASSURANCE

- A. Acceptable manufacturers:
 1. The equipment/products described herein and furnished per these specifications are all Owner preferred products. Substitutions will only be considered when in accordance with SECTION 01 25 00 – SUBSTITUTION PROCEDURES in Division 1.
 2. A single manufacturer or teamed manufacturer's certifiable solution except for data racks and other hardware that is not identified, as part of the channel test configuration by ANSI/TIA/EIA 568-B will supply products listed in this section.
 3. The approved manufacturer's warranty shall provide a Category 6A solution with a 20-year warranty.
 4. Manufacturer will be ISO 9001 Certified with a minimum 7 years' experience in specified products manufacture.
 5. Acceptable Category 6A product cable and connectivity shall be a complete end-to-end solution.
- B. Installer Qualifications:
 1. Structured Cabling System Installer shall be licensed and shall meet all applicable regulations of the State of Texas and Department of Labor insofar as they apply to this type of system. The proposer shall be a firm normally employed in the low voltage and data cabling industry.
 2. Structured Cabling System Installer shall comply with all federal, state, and local laws.
 3. Structured Cabling System Installer shall be certified by the cable manufacturer in all aspects including design, installation, and warranty service of products listed in this document.
 4. Structured Cabling System Installer shall provide a list of five (5) similar size projects, a brief description of the project with contact names and phone numbers.
 5. Structured Cabling System Installer must have a minimum of 5 years' experience installing structured cabling systems of similar size.
 6. Structured Cabling System Installer will use only authorized manufactured components.
 7. All on site installers must be employees of the certified Structured Cabling System Installer and at least 25% of the staff must have attended manufacturer provided training. Current certification documents shall be available upon request and included in the Structured Cabling System Installer's product submittals.
 8. A Quality Assurance Program with internal inspections to ensure work is performed according to internal as well as industry standards.
 9. Structured Cabling System Installer shall own and maintain tools and equipment necessary to properly install fiber optic cabling, Category 6A and Category 3 distribution systems.
 10. The College reserves the right to reject any bid of any Structured Cabling System Installer who has previously failed to complete projects properly, on time, or failed to perform properly.
 11. The selected, certified system partner that provided pricing, for the scope of work

associated with this specification section and associated contract drawings, shall be the installer of the system. No subcontracting of any portion of this systems scope of work will be allowed beyond the original SCS proposing contractor.

- C. Pre-Construction Meeting:
1. The successful Structured Cabling System Installer will attend a mandatory pre-construction meeting with the project consultant, College technology representative, general contractor, and any other individual deemed necessary by the Owner's representative prior to project start up. Work will not begin until after this meeting.
- D. Acceptance:
1. The Owner's representative reserves the right to reject all or a portion of the work performed, either on technical or aesthetic grounds.
- E. Warranty:
1. The selected Structured Cabling System Installer shall be a certified installing contractor of the approved manufacturer's solution and hold current certification. Structured Cabling System Installer shall provide an end-to-end performance warranty of no less than 20-years on all products installed. The proposer shall provide current certification documentation. The performance warranty shall be issued by the manufacturer and shall warrant that ALL Category 6A cable channels have been tested bi-directionally (end to end) using a Level IIIIE tester, per TSB-67, and that all test results conform to the most current TIA/EIA-568-B.2-10 and TSB-67 channel values.
 2. The warranty will stipulate that all products used in this installation meet the prescribed mechanical and transmission specifications for such products as described in ISO/IEC 11801, ANSI/TIA/EIA-568-A, or EN 50173. Quality and workmanship evaluation shall be solely by the Owner/Designer and designated representatives.
 3. Structured Cabling System Extended Product Warranty and Application Assurance Program Extended Product Warranty: coverage includes product defects for all Data Cable Systems Installer and all installed Structured Cabling System components.
 4. The manufacturer's warranty starts the date of project warranty certification issue to the College from the manufacturer.
 5. Coverage includes
 - a. All components of the registered SCS to be free from manufacturer defects in material and workmanship under normal and proper use
 - b. All components of the registered SCS will exceed the TIA 568-B.1, B.2, B.3 and exceed ISO/IEC 2nd Edition standards and will confirm to the performance specifications of the manufacturer's associated product data sheet in effect at the time of warranty certification issuance.
 - c. Installation exceeds the requirements of the TIA 568-B and the ISO/11801 2nd Edition Standards for cabling links/channel configurations insertion and return loss, attenuation and near end cross talk for the insertion and return loss, attenuation and near end crosstalk.
 - i. Each channel (All components are manufacturer's Category 6A passive products end-to end) will be capable of delivering 1.0 Gbps to the workstation according to the application standards.
 6. Product Warranty, Manufacturer will (at its own expense)
 - a. Repair or replace defective product
 - b. Pay an authorized installer to repair or replace any defective product.
 - c. Replacement parts will be new. No remanufactured or used parts allowed.

7. Structured Connectivity Solutions Extended Product Warranty and Application Assurance shall be provided at job completion.

1.4 REGULATORY REQUIREMENTS

- A. Standards: All work shall be performed in accordance with the latest revisions of the following standards and codes:
 1. Latest Local Codes and Amendments
 2. Latest National Electrical Code

- B. Other References:

ANSI/TIA/EIA-568-B.1, COMMERCIAL BUILDING TELECOMMUNICATIONS CABLING STANDARD (AND ALL PUBLISHED ADDENDA), PART 1: GENERAL REQUIREMENTS, current version.

ANSI/TIA/EIA-568-B.2, COMMERCIAL BUILDING TELECOMMUNICATIONS CABLING STANDARD (AND ALL PUBLISHED ADDENDA), PART 2: BALANCED TWISTED PAIR CABLING COMPONENTS, current version.

ANSI/TIA/EIA-568-B.2-10 (CURRENT DRAFT), COMMERCIAL BUILDING TELECOMMUNICATIONS CABLING STANDARD, ADDENDUM 10: TRANSMISSION PERFORMANCE SPECIFICATIONS FOR 4-PAIR AUGMENTED CATEGORY 6A CABLING.

ANSI/TIA/EIA-568-B.3, OPTICAL FIBER CABLING COMPONENTS STANDARD, current version.

NATIONAL FIRE PROTECTION ASSOCIATION, INC., NFPA 70: NATIONAL ELECTRIC CODE (NEC), current version.

1. NEC ARTICLE 250: GROUNDING
2. NEC ARTICLE 386: SURFACE METAL RACEWAYS
3. NEC ARTICLE 388: SURFACE NON-METALLIC RACEWAYS
4. NEC ARTICLE 800: COMMUNICATIONS CIRCUITS
5. NEC ARTICLE 770: OPTICAL FIBER CABLES AND RACEWAY
6. *ANSI/TIA/EIA-569-B*, COMMERCIAL BUILDING STANDARDS FOR TELECOMMUNICATIONS PATHWAYS AND SPACES, current version.
7. *ANSI J-STD-607-A*, COMMERCIAL BUILDING GROUNDING AND BONDING REQUIREMENTS FOR TELECOMMUNICATIONS, current version.
8. *ANSI/TIA/EIA-942*, TELECOMMUNICATIONS INFRASTRUCTURE FOR DATA CENTERS, 2004.
9. *ANSI/ICEA S-83-596*, FIBER OPTIC PREMISES DISTRIBUTION CABLE, current version.
10. *ANSI/TIA/EIA-598*, COLOR CODING OF OPTICAL FIBER CABLES, current version.
11. *ANSI/ICEA S-87-640*, FIBER OPTIC OUTSIDE PLANT DISTRIBUTION CABLE, current version.
12. *ANSI/TIA/EIA-492AAAC*, DETAIL SPECIFICATION FOR 850NM LASER-OPTIMIZED 50UM CORE DIAMETER/125 UM CLADDING DIAMETER CLASS 1A GRADED INDEX MULTIMODE OPTICAL FIBERS, current version.
13. *ANSI/TIA/EIA-492CAA*, DETAIL SPECIFICATION FOR CLASS IVA DISPERSION-UNSHIFTED SINGLEMODE OPTICAL FIBERS, current version.
14. *ANSI/TIA/EIA-758*: CUSTOMER-OWNED OUTSIDE PLANT TELECOMMUNICATIONS CABLING STANDARD, current version.
15. *ANSI/TIA/EIA-526-7*, OPTICAL POWER LOSS MEASUREMENTS OF INSTALLED SINGLEMODE FIBER PLANT: OFSTP-7, current version.
16. *ANSI/TIA/EIA-526-14-A*, OPTICAL POWER LOSS MEASUREMENTS OF INSTALLED MULTIMODE FIBER PLANT: OFSTP-14A, current version.

17. TIA/EIA-TSB-125, GUIDELINES FOR MAINTAINING OPTICAL FIBER POLARITY THROUGH REVERSE-PAIR POSITIONING, current version.
18. TIA/EIA-TSB-140, ADDITIONAL GUIDELINES FOR FIELD TESTING LENGTH, LOSS, AND POLARITY OF OPTICAL FIBER CABLING SYSTEMS, current version.
19. UNDERWRITER'S LABORATORY, INC. (UL)
 - a) *UL-5A: Standard for Non-Metallic Raceways and Fittings*
 - b) *UL-5: Standard for Surface Metal Raceways and Fittings*
 - c) *UL-5C: Standard for Surface Raceways and Fittings for Use with Data, Signal, and Control Circuits*
 - d) *UL-50: Standard for Enclosures for Electrical Equipment*
 - e) *UL-94-V0: Tests for Flammability of Plastic Materials*
 - f) *UL-498: Attachment Plugs and Receptacles*
 - g) *UL-1479: Fire Tests of Through-penetration Firestops (in Accordance with ASTM E814).*
 - h) *UL-1863: Standard for Safety of Communications Circuit Accessories*
20. NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)
 - a) *ANSI/NEMA WD-6-2002: Wiring Devices – Dimensional Requirements*
 - b) *NEMA 250-2003: Enclosures for Electrical Equipment*
21. ISO/IEC 11801, ED. 2:2002, INFORMATION TECHNOLOGY – GENERIC CABLING FOR CUSTOMER PREMISES, current version.
22. ISO/IEC 18010, INFORMATION TECHNOLOGY – PATHWAYS AND SPACES FOR CUSTOMER PREMISES CABLING, current version.
23. ISO/IEC 14763-1, INFORMATION TECHNOLOGY – IMPLEMENTATION AND OPERATION OF CUSTOMER PREMISES CABLING – PART 1: ADMINISTRATION, current version.
24. FEDERAL COMMUNICATIONS COMMISSION (FCC) TITLE 47, CODE OF FEDERAL REGULATIONS, PART 68: CONNECTION OF TERMINAL EQUIPMENT TO THE TELEPHONE NETWORK, current version.
25. ANSI/TIA/EIA-569-B, COMMERCIAL BUILDING STANDARDS FOR TELECOMMUNICATIONS PATHWAYS AND SPACES, current version.
26. ANSI/TIA/EIA-606-A, ADMINISTRATION STANDARD FOR COMMERCIAL TELECOMMUNICATIONS INFRASTRUCTURE, current version.
27. ANSI/EIA-310-D, CABINETS, RACKS, PANELS, AND ASSOCIATED EQUIPMENT, 1992.
28. ANSI/TIA/EIA-604 (SERIES), FOCIS FIBER OPTIC CONNECTOR INTERMATEABILITY STANDARD, current version.
29. U.S. PUBLIC LAW 336. 101ST CONGRESS, ADA: AMERICANS WITH DISABILITIES ACT OF 1992.
30. 802.3af-2003 - IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications - Data Terminal Equipment (DTE) Power Via Media Dependent Interface (MDI).
31. IEEE 802.3AT (CURRENT DRAFT), DATA TERMINAL EQUIPMENT (DTE) ENHANCED POWER OVER MEDIA DEPENDENT INTERFACE (MDI).
32. IEEE 802.3AN-2006 - IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems – LAN/MAN - Specific Requirements Part 3: CSMA/CD Access Method and Physical Layer Specifications - Amendment: Physical Layer and Management Parameters for 10 Gb/s Operation, Type 10GBASE-T
33. IEEE 802.3AE, SPECIFICATION FOR 10 GBIT/S ETHERNET OPERATION OVER OPTICAL FIBER.

34. TELECOMMUNICATIONS DISTRIBUTION METHODS MANUAL, 12TH ED., BUILDING INDUSTRY CONSULTING SERVICES INTERNATIONAL (BICSI), 2009.
 35. INFORMATION TRANSPORT SYSTEMS INSTALLATION MANUAL, 6TH ED., BUILDING INDUSTRY CONSULTING SERVICES INTERNATIONAL (BICSI), 2010.
- C. Governing Codes and Conflicts:
1. If the requirements of these specifications or the Project Drawings exceed those of the governing codes and regulations, then the requirements of these specifications and the Drawings shall govern. However, nothing in the Drawings or Specifications shall be construed to permit work not conforming to all governing codes and regulations.

1.5 ABBREVIATIONS

- A. The following abbreviations are used in this document:
- | | |
|------|-------------------------------------|
| DC | Direct Current |
| IDF | Intermediate Distribution Frame |
| MDF | Main Distribution Frame |
| PBX | Private Branch Exchange |
| UTP | Unshielded Twisted Pair |
| SCS | Structured Cabling System |
| SCSI | Structured Cabling System Installer |

1.6 SUBMITTALS

- A. Project Initiation:
1. Awarded contractor provides 4 copies of submittal within 14 days of Notice to Proceed
 2. Cover Sheet with Information, Pricing and Materials
 3. Cover sheet
 - a. Company name and logo
 - b. Submittal Title
 - c. Client name
 - d. Business Address
 - e. Point of Contact
 - f. Contact information (phone number)
 4. Product Data
 - a. Manufacturer's catalog information showing (items must be clearly identified in the page (use a red arrow to point to the item)
 - b. All items listed in the "Product's" section of Part 2 and specification sheets for
 - i. All Connectors
 - ii. All termination components for each component type
 - iii. All ground and surge suppression equipment
 - c. Manufacturer's cut sheets for all products with each item clearly identified
 - d. Technical data sheets for showing full swept frequency range of Guaranteed Channel Performance
 - e. Technical data sheets to include physical as well as the following transmission and electrical characteristics
 - i. Wire map
 - ii. Length
 - iii. Insertion Loss
 - iv. Near End Crosstalk
 - v. Power Sum Near End Crosstalk

- vi. Equal Level Far End Cross Talk
- vii. Power Sum Equal Level Far End Crosstalk
- viii. Return Loss
- ix. Propagation Delay
- x. Delay Skew
- 5. Manufacturer's Instructions
 - a. Application conditions and limitations of use as stipulated by product testing agency's regulatory requirements
 - b. Storage, handling protection, examination, preparation, installation instructions
- 6. Pre-Qualification Certificate
 - a. Documentation showing completion of pre-qualification requirements
 - b. Manufacturer's letter indicating successful completion of pre-qualification requirements
 - c. Certificates for design, engineering, and installation
- 7. Factory Test
 - a. Factory test information submitted prior to installation
 - b. Any substituted products must be verified and justified to be equivalent
 - c. Any and all substitutions will be approved in writing by the Owner.
- 8. Material Guarantee
 - a. Data Cabling System Installer guarantees Category 6A and fiber optic cabling and components meet or exceed ANSI/TIA/EIA-568-B.1, 568-B.2, 568-B.3 and 589 at time of bid.
- 9. Warranty Documentation
 - a. Warranty: life of installed product
 - b. Warranty documentation clearly explains manufacturer's warranty and is included in proposal. A sample warranty is provided with the procedure for processing support requests.
 - c. Application assurance manual which documents the vendor supported applications guidelines will be included in the submittal.
- 10. Test Equipment
 - a. Copper UPT Test Equipment
 - i. Make and Model Number
 - ii. Software version
 - iii. Quantity
 - b. Fiber Optic Test Equipment
 - i. Make and Model Number
 - ii. Software version
 - iii. Quantity
 - c. Submit a current test sample (one per test set)
 - d. Quality Assurance/Control Submittals
 - i. Quality Assurance/Control Submittals
 - ii. Make and Number
 - iii. Software revision
 - iv. Quantity
- B. Shop Drawings:
 - 1. Submit the following items, for Owner review and approval, within twenty-eight (28) days of notice to proceed:
 - a. Submitted drawings shall indicate the following:
 - 1. Submitted drawings shall indicate the following:
 - 2. SCSI will verify station cabling and MDF-to-IDF routings
 - 3. Location of all wall penetrations (all penetrations shall be sleeved and have protective bushings at both ends)
 - 4. Location of sleeved wall pass-thru
 - 5. Sleeve size at each installed location

6. Cable quantity passing through each sleeve
 7. Location of drop in each room. Room labeling will be according to IDF number, patch panel number, port number
 8. Identify cable routing, size, quantity, and stub-up locations for all floor mounted outlets
- b. Drawing Compliance: A letter shall be provided stating that the SCS installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter.
- C. Close-out Procedures:
1. Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance. The close out submittals shall include:
 - a. Inspection and Test Reports: During the course of the Project, the Contractor shall maintain an adequate inspection system to ensure that the materials supplied, and the work performed, conform to contract requirements. The Contractor shall provide written documentation that indicates that materials acceptance testing was conducted as specified. The Contractor shall also provide documentation, which indicates that all cable termination testing was completed and that all irregularities were corrected prior to job completion. Manufacturer's representative shall inspect and certify all work to validate the manufacturer's warranty.
 - b. Provide complete test reports for all cabling and devices that comprise system as outlined in this document. Test results will be electronic in both native and PDF formats. The software for the native format must be included at no additional cost to the owner.
 - c. Include the Name, address, and telephone of the authorized factory representative with a 24-hour emergency service number.
 - d. The manual shall also include Manufacturer's data sheets and installation manuals/instructions for all equipment installed, and a list of recommended spare parts. Spare parts will be included.
 - e. Generic or typical owner's instruction and operation manual shall not be acceptable to fulfill this requirement.
 - f. An up-to-date record ("as-built") set of approved shop drawing prints that have been revised to show each change made to the structure cabling system from the original approved shop drawings. Drawings shall consist of a scaled plan of each building showing the placement of each individual item of the technical cabling system equipment as well as raceway size and routing, junction boxes, and conductor size, quantity in each raceway. Only blue cabling will be used on this project.
 - g. As-built Drawings shall include cable pathways, circuit termination locations with correct labeling and MDF/IDF locations. The as-built drawings shall be prepared using AutoCad 2002 or later. Provide the Owner with electronic versions of the as-builts on CD media in AutoCAD, Visio and PDF format. Also, the as-built drawings are to be posted on laminated sheets in the each MDF/IDF closet for owner's reference.
 - h. A hard copy as well as an electronic copy of the manufacturer's warranty shall be included in the close-out documents.
 - i. Any keys to cabinets and/or equipment and special maintenance tools required to repair, maintain, or service the system.
 - j. Operating and Maintenance Instructions for all devices within the system. These instructions shall reflect any changes made during construction, and

shall be provided to the Owner, for their use, in a three-ring binder labeled with the project name and description. This shall include 3 hard and electronic copies in color.

- k. Upon completion of the work and at a time designated by the Architect or owner, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all included systems and equipment. Minimum amount of training time shall be at least 4 hours of training and shall include phone support as needed.
- l. One (1) 30" X 42" laminated floor plan sheets illustrating fiber, copper, technology drops with correct number scheme, and cable designations. Contractor will provide one complete floor plan of each IDF room (to be mounted in each IDF room). The laminated floor plan of the MDF fiber and copper will be an addendum sheet only.

1.7 SPECIFICATIONS

- A. Only Data Cable System Installers certified in the approved manufacturer's solutions are invited to submit bid.
- B. Documentation required for bid response:
 - 1. Certification by manufacturer
 - 2. Certification must be current with eligibility date.
 - 3. Provide a list of current projects that Data Cable System Installer will be working during the same time as this project and the workforce needed at each installation.
 - 4. Data Cable System Installer must submit 3 or more references of projects of similar scope with the following information:
 - a. Size of Project
 - b. Drop count
 - c. Number of wiring closets (MDF/IDFs)
 - d. Total cost of Project
 - e. Services provided
 - f. References must be similar in size and scope
 - g. Document will be submitted within 15 days of Data Cable System Installer selection
 - 5. Provide list of all projects within the last 3 years
 - a. Project location
 - b. Contact information
 - c. Project size
 - d. Approximate budget
 - e. Document will be submitted within 15 days of Data Cable System Installer selection
 - 6. Provide system installation certification covering manufacturer's link/channel specifications for a minimum of 20 years.
 - 7. Provide a sample warranty applicable to the completed project.
 - 8. Provide warranty support processing documentation
 - 9. Provide proof of qualifications with the proposal:
 - a. Technical experience of Project Manager's experience and online supervisor assigned to the project.
 - b. Project Manager will have 5 years' experience on projects of similar size and scope
 - c. Project Foreman will have 3 years minimum project experience working crews of 4 or more.
 - d. List of product-related training attended by Data Cable System Installer staff.

- C. Workers on site are employees of the Data Cabling System Installer. Every employee will be properly trained by the manufacturers of the installed products.

1.8 CABLING REQUIREMENTS

- A. A. Cable Pathway
1. All network cabling that is concealed in walls and exposed above ceiling grid level in plenum spaces:
 - a. Shall be in conduit installed by the electrical contractor with nylon bushings.
 - b. Cable tray and J-Hook method of delivery system, which is provided and installed by the Data Cabling System Installer.
 2. Conduits are to be free of dirt and debris prior to cable installation.
 - a. Failure to clean out debris results in replacing cabling at Data Cabling Installer's sole expense.
 3. Velcro straps are not a suitable method to change the direction of a cable bundle.
 4. Cable trays shall exit the cable trays vertically using cable drop assemblies or "waterfalls" at all times. Cables that are not properly dressed which turn vertically over right angles or wire baskets will be in violation of bend radius requirements.
 5. Cabling that violates the bend radius rule will be replaced at Data Cabling System Installer's expense.
 6. *No plastic tie wraps are allowed* for use in structured pathway cabling.
 7. All cabling found bundled by plastic tie wraps will be replaced at Data Cabling System Installer's expense.
- B. Hardware
1. A complete and functioning system requires hardware including (but not limited) to UTP cabling, fiber backbone, patch panels, fiber termination sleeves, equipment racks, cable trays, ladder racks, vertical wire management, termination blocks, data and voice outlets, connectors, fiber and copper patch cables, and all other accessories needed to provide a complete and functioning system.
 2. All outlets (both copper and fiber) must be protected from construction related dust. Outlets not protected will be replaced at Data Cabling System Installer's expense.
 3. Dust proof barriers will remain in place after the final testing phase is complete.

1.9 GROUNDING AND BONDING

- A. All grounding and bonding will be according to National Electrical Code and any local codes pertaining to grounding and bonding requirements.
- B. Bonding and Grounding
1. Bonding and Grounding will adhere to 607-Standards.
 2. Communication bonding and grounding will be according to the National Electrical Code and the National Fire Protection Association.
 3. Horizontal Cabling will be according to ANSI/NFPA 70 as well as any local requirements and practices.
 4. Horizontal equipment includes cross connect frames, patch panels, racks, active telecommunication equipment and test apparatus and equipment.
 5. Where directed by local code, provide a Telecommunication Bonding Backbone utilizing a #6-AWG or larger bonding conductor that provides direct bonding between equipment rooms and telecommunications rooms.
 6. Note: this is part of the grounding and bonding infrastructure (telecommunications pathways and spaces within the building structure) and is independent of any equipment or cable.

1.10 SPECIAL REQUIREMENTS FOR CABLING ROUTING AND INSTALLATION

- A. Cabling
 - 1. All communications cabling used shall comply with the NEC Articles 725, 760, 770, 800 as well as the relative local codes
 - 2. All copper cabling has the applicable markings for the installed environment.
 - 3. All fiber optic cabling has the applicable markings for the installed environment.
- B. Cable Pathways
 - 1. Data Cable Systems Installer coordinates cable placement with the General Contractor during the painting phase of the construction in order to avoid paint on the cabling. Note: If Data Cable System Installer fails to coordinate with the General Contractor, any cables that get coated with paint will be replaced at Data Cable System Installer's sole expense.
 - 2. Required cable bundle placement in shared pathways is noted on the drawings.
 - 3. In suspended ceilings and other areas where duct, cable trays or conduit are not available, Contractor will bundle (maximum of 48) station wiring using Velcro straps snug so as not to deform the cable geometry.
 - 4. Cables will be supported by "J" hooks and/or saddles/slings securely attached to existing building structure and framework no greater than five (5) foot intervals.
 - 5. Bundle cables in pathways with Velcro only. Cable ties are not permitted on any cable at any time. This includes both installation and post-installation phase.
 - 6. Data Cable System Installer will strictly follow Manufacturer's bend radius as well as cable pulling tension requirements.
 - 7. No cabling should be attached to lift out ceiling grid supports or laid directly on ceiling grid or tiles.
 - 8. No cabling to be attached to or supported by the fire sprinkler system including the heads or delivery system.
 - 9. No cabling to be attached to or supported by any environmental sensors in ceiling air space or duct work.
 - 10. Cables found violating the above requirement will be removed, pathway corrected, and then cable reinstalled at Data Cable System Installer's sole expense.
- C. All data ports and outlets must be always protected from contaminants such as dust and debris. Fire Stopping
 - 1. Equipment and practices must comply with applicable national and local codes.
 - 2. Data Cabling Systems Installer responsible for sealing all cable pass through in walls rated fire rated and smoke, and any openings created between floors.
 - 3. Proper sealing is required. Sealing material and material application must be acceptable to local fire and building authorities as well as authorities having the highest jurisdiction.
 - 4. Data Cabling System Installer is responsible for creating only those openings as is necessary for cable passage between locations shown on the drawings.
 - 5. All openings created by Data Cabling System Installer must be sealed.
- D. Data Cable System Installer Responsibility (Sole Expense)
 - 1. Data Cable System Installer is responsible for damage to any surface or work disruption caused by him. (Any repairs including but not limited to surface repair or painting will be included as deemed necessary.)
 - 2. Data Cable System Installer will make restitution for all damages caused by his work.

1.11 SPECIAL REQUIREMENTS FOR CABLING ROUTING AND INSTALLATION

- A. Horizontal Cabling
 - 1. Data Cable System Installer supplies the cabling to connect outlet to the backbone subsystem on same floor.

2. The type horizontal cabling used for each work location will be 4-pair UTP unless otherwise noted.
3. The College utilizes star topology from the wiring closets to the outlet.
4. The length of each individual run will not exceed 290 feet.
5. Cable to be installed according to manufacture instructions as well as Category 6A industry standards.
6. Any cabling found in violation of any standards listed in this document will be replaced at Data Cable System Installer's sole expense.
7. Contactor will coordinate with electrical contractor for final pathways.
8. All cable routes to be approved by the Architect and the College prior to cable installation.
9. During initial cable installation (rough-in), cable shall be always protected.
 - a. Cable will not be left on the floor.
 - b. Cable will be protected in open boxes, slings that are properly used, and approved barricades.
 - c. Cable shall NOT be suspended by tie wraps or any other method that can compromise the integrity of the cable.
 - d. Wide-base support systems must be used (according to bundle size) to support cable during the rough-in.
 - e. Any cable not handled properly or protected and deemed damaged will be replaced at Data Cable System Installer's sole expense.
10. Data Cable System Installer shall not install cable in any conduit prior to the installation of conduit bushings.
 - a. Electrical contractor will furnish and install conduit bushings on all low voltage conduits.
 - b. Anticipated cable installation delays caused by conduit bushings that installed will should be immediately brought to the attention of the General Contractor and Architect.
 - c. Cable that is installed in conduits without bushings will be replaced at the Structured Cabling System Installer's expense.
 - d. No installation of conduit bushings after the cable is pulled through the conduit is acceptable.
11. Recommended radius bend and pulling strength requirements for 4-pair UTP will be always observed during handling and installation.
 - a. Avoid bending bends that deform cable jacket.
 - b. Push slack cable above the ceiling level to avoid radius violations in the in back box.
 - c. Cables leaving J-Hooks to conduit stubs requires a gradual sweep and not have sharp turns.
12. Each cable run from the patch panel to the room outlet will be continuous without any joints or splices.
13. Cable runs should not be run in electrical rooms.
14. Cable runs shall not run parallel to electrical pathways without proper separation.
15. In areas where cable trays or conduit is not available, station cables will be bundled with Velcro straps at appropriate distances (no sagging).
 - a. Cable will be supported by J-Hooks attached to the existing building structure and framework.
 - b. Do not mix different types of transmission media in the same J-Hook. For example, Fiber optic cable and Category 6A may not be mixed.
16. Cables are not supported by duct work.
17. Building support system are not acceptable supports. Cables should not wrap around the building structure.
18. Horizontal cabling will be concealed in interior walls. If obstructions exist, approval must be obtained from the Architect and owner prior to the use of an alternate method.

19. Any damage to the ceiling grid or tiles caused by the cabling contractor will be paid for by the cabling contractor.
20. All 4-pair UTP cabling will be UL rated.
21. Conduit installed by Data Cabling Installation contractor will not exceed 100 feet or have more than two 90° (90 degree) bends without the use of pull boxes. The Architect must approve the configuration.
22. All station cables and tie cables will be run at right angles to electrical power circuits.

PART 2 – PRODUCTS

2.1 EQUIPMENT RACKS

- A. 2-Post Open Frame Racks
 1. Design Make shall be:
 - a. Hoffman / nVent
 - b. Part Number: EDR19FM45U, 3-in. Column, 19" x 7', Black.
- B. 4-Post Open Frame Racks
 1. Design Make shall be:
 - a. Hoffman / nVent
 - b. Part Number: E4DR19FM45U, Tapped Holes, 45RU, 19" x 7', Black.
- C. Wall Mount Network Enclosure
 1. Design Make shall be:
 - a. Hoffman / nVent
 - b. Part Number: EWMW242425, Tapped Holes, 12RU, 24" x 24" X 24", Black.

2.2 VERTICAL CABLE MANAGEMENT

- A. Vertical Cable Management for Racks/Frames
 1. Every rack/frame shall have two vertical cable managers. The vertical cable manager shall create a space for storing and organizing cables along the side of the rack/frame. The cable manager shall maintain separation between patch/equipment/jumper cords and premise cables.
 2. The vertical cable manager shall match the height of the rack(s)/frame(s).
 3. The vertical cable manager shall bolt to the side of racks/frames with included hardware.
 4. Design Make shall be:
 - a. Hoffman / nVent
 - b. Part Number DV10S7, Single-Sided Vertical Cable Management, 10.25" Wide x 84" Long. Black Hinge Cover.

2.3 HORIZONTAL CABLE MANAGEMENT

- A. Horizontal Cable Management for Racks/Frames – **See installation instructions in section 3.5.**
 1. Design Make shall be:
 - a. Hoffman / nVent
 - b. Part Number DCHS1, Single-Sided Horizontal Cable Manager, 1U x 19" Wide, Black.

2.4 LADDER RACK, SUPPORTS, AND ACCESSORIES

A. Ladder Rack

1. Design Make:
 - a. Hoffman / nVent
 - b. Part Number LSS12BLK, Ladder Rack, 12" (457 mm) Wide, Black.
- B. The cabling contractor shall provide and install all Hoffman / nVent ladder rack, supports, and accessories to ensure a complete and functional system that is properly bonded and grounded.

2.5 J-HOOKS

- A. The J-Hooks will have a wide base design and smooth beveled edges to provide a large bending radius for current and future high-performance data cables and fiber optics.
- B. J-Hooks offer a solution that meets industry standards for Cat 6A and easily accommodates large-diameter fiber optic, inner duct, and coax cable.
- C. The J-Hooks are designed to provide a strong and stable pathway support installation.
- D. Provides optimal support for high-performance data cable, up to and including Cat 5e, Cat 6, Cat 6A, and fiber optic cables
- E. Rounded edges on J-Hooks provide proper bend radius support for high performance data cables
- F. Multiple color options aid in the identification and organization of the pathway application
- G. Provides superior fill capacity and load rating over most other non-continuous cable support alternatives
 1. Category 5e – 50 Cables
 2. Category 6 – 35 Cables
 3. Category 6A – 25 Cables
- H. Compliant with UL® 2043 and suitable for use in air handling (plenum) spaces
- I. J-hooks do not require to be grounded
- J. Meets ISO®/IEC 14763-2, ANSI/TIA 568 and ANSI/TIA 569
- K. Erico/Caddy Cat 32

2.6 CONDUIT SYSTEMS

- A. Conduit
 1. Approved manufacturers
 - a) for galvanized rigid conduit (GRC), intermediate metallic conduit (IMC), and electrical metallic tubing (EMT) are
 - 1) Triangle
 - 2) Allied
 - 3) Wheatland.
- B. Datacom/AV/Electrical box
 1. Gangable AV Wall Boxes are a solution for in wall applications requiring AV, data and power integration.
 2. Concentric 1"- 2" knockouts combined with a 4-inch depth facilitate easy installation of AV cables incorporating pre-connectorized heads and bend radii required for high performance Category 6A and 6A cables.
 3. Designed to be installed independently or ganged together to receive any number of devices, allowing them to accept any standard wall plate.
 4. The Gangable AV Wall has a built-in adjustable sheetrock locating bracket to adjust to the depth of the sheetrock.
 5. The Gangable AV Wall can be installed in 2, 3, 4, 5, 6 gang applications.

6. A ground screw available in each gang so that regardless of what services are brought into the box there is a means of grounding readily available.
7. The metallic low voltage partition is available to separate electrical from low voltage and can be use used to divide other low voltage applications.
8. A metallic low voltage partition is available for both boxes and is adjustable to accommodate any number of gangs.
9. Approved manufacturer of Datacom/AV/Electrical box is:
 - a) 2 gang – Hubbell HBL985
 - b) gang – Hubbell HBL986

2.7 FIBER CABLING – BACKBONE

- A. Multimode Optical Fiber Cable: **USED FOR ALL OTHER BACKBONE CONNECTIONS**
 1. 24-fiber, Tight-Buffered, OM3 Multimode, Premises Distribution Indoor/Outdoor Plenum Cable with Interlocking Armor, Part Number: Leviton Manufacturer
 - a. Part Number: Berk-Tek PDPK012FB3010/F5-I/O-C4C5(AQU).
 - b. Coordinate strand count with Owner prior to installation
 - c. Or Owner approved equal.
- B. Single mode Optical Fiber Cable:
 1. 24-fiber, Tight-Buffered, OS2 Single mode, Premises Distribution Indoor/Outdoor Plenum Cable with Interlocking Armor
 - a. Part Number: Berk-Tek PDPK012AB0707-I/O-C4C5(YEL).
 - b. Coordinate strand count with Owner prior to installation
 - c. Or Owner approved equal.

2.8 COPPER CABLING – BACKBONE

- A. Fused Telecom Building Entrance Terminal:
 1. Building Entrance Terminal (Indoor), IDC style 66 Block input and output, 50-Pairs
 - a. Part Number: Circa 2650QC/QC.

2.9 FIBER OPTIC TERMINATION ENCLOSURES and SPLICE TRAYS.

- A. 1000i SDX 1RU Distribution and Splice Enclosure, empty, with sliding tray.
 - a. Accepts up to (3) SDX adapter plates or (3) SDX MTP cassettes and accepts up to (3) splice trays.
 - b. Part Number: Leviton 5R1UM-S03.
- B. 1000i SDX 2RU Distribution and Splice Enclosure, empty, with sliding tray.
 - a. Accepts up to (6) SDX adapter plates or (6) SDX MTP cassettes and accepts up to (6) splice trays.
 - b. Part Number: Leviton 5R2UM-S06.
- C. 1000i SDX 4RU Distribution and Splice Enclosure, empty.
 - a. Accepts up to (12) SDX adapter plates or (12) SDX MTP cassettes and accepts up to (12) splice trays.
 - b. Part Number: Leviton 5R4UM-F12.

2.10 FIBER OPTIC ADAPTER PLATES

- A. SDX Precision Molded Plate (AQUA), Use for OM3/4 Fiber Optic System.
 - a. 50/125um Multimode Laser Optimized OM3/4, Duplex LC, 12 fibers, Zirconia Ceramic Sleeve
 - b. Part Number: Leviton 5F100-2QL.

- B. SDX Precision Molded Plate (AQUA), Use for OM3/4 Fiber Optic System.
 - a. 50/125um Multimode Laser Optimized OM3/4, Quad LC, 24 fibers, Zirconia Ceramic Sleeve
 - b. Part Number: Leviton 5F100-4QL.
- C. SDX Precision Molded Plate (BLACK)
 - a. Adapter Plate, blank
 - b. Part Number: Leviton 5F100-PLT
 - c. Blanking plates shall be installed in any unused fiber enclosure openings.
- D. OM3/OM4 Fiber Optic Connectors (aqua): Use for OM3/OM4 Fiber Optic System.
 - a. FastCAM Pre-polished Connector, LC (aqua), 50/125µm Laser Optimized Multimode
 - b. Part Number: Leviton 49991-LLC

2.11 PATCH CORDS/JUMPERS

- A. OS1/OS2, yellow. Factory-terminated, double-ended, 2-strand multimode cordage, UPC polish. Use for OS2 Fiber Optic System
 - a. 9/125 µm Single-mode (OS2) OFNR
 - b. Duplex LC-Duplex LC:
 - 1) Part Number: Leviton UPDLC-S01 (1 meter)
 - 2) Part Number: Leviton UPDLC-S02 (2 meter)
 - 3) Part Number: Leviton UPDLC-S03 (3 meter)

2.12 STATION CABLING – WORK AREA OUTLETS

A. MANUFACTURERS

- 1. **Berk-Tek, a Leviton Company 132 White Oak Road, New Holland, PA 17557, Phone: 800-237-5835, Website www.berktek.us.**

2.13 STATION CABLING – WORK AREA OUTLETS

- A. Category 6A Unshielded Twisted Pair:
 - 1. 100-ohm, Category 6A, 23 AWG, 4-pair unshielded twisted pair, LM-RDT, CMP rated.
 - a. Color: Blue. For all Data Cables.
 - b. Part Numbers: Reel: 11141650
 - c. Maximum Cable Diameter: 0.230 inch.
 - d. Berk-Tek LM-RDT CMP
 - e. Or Owner approved equal.
- B. Category 6A Modular Jacks:
 - 1. Leviton 8-position eXtreme QuickPort modular jack, Category 6A, IDC terminals, T568A/B wiring scheme.
 - a. Color: blue.
 - b. Each Connector: Identified on its face as CAT 6A.
 - c. Part Number: Leviton 6110G-RL6 (blue). For security/access control applications.
 - d. Or Owner approved equal.

- C. Leviton Category 6A Modular Patch Cords:

1. Leviton, Category 6A, shielded cord (use same cord for shielded or unshielded systems) 4-pair, stranded wire construction.
 - a. Color: Red
 - b. Part Numbers:
 - 1) Leviton 6AS10-07R (7 feet, Red). For Fire or security/access control applications at device end.
 - 2) Leviton 6AS10-10R (10 feet, Red). For Fire or security/access control applications at device end.
 - 3) Leviton 6AS10-15R (15 feet, Red). For Fire security/access control applications at device end.
 - c. Or Owner approved equal.

 2. High-flex Small Diameter, 28-gauge, Category 6A, shielded cord (use same cord for shielded or unshielded systems) 4-pair, stranded wire construction.
 - a. Color: Blue.
 - b. Part Numbers:
 - 1) Leviton H6A10-07L (7 feet, Blue). For Data applications at patch panel end.
 - 2) Leviton H6A10-10L (10 feet, Blue). For Data applications at patch panel end.
 - 3) Leviton H6A10-15L (15 feet, Blue). For Data applications at patch panel end.
 - c. Note: When using 28-gauge patch cords, derate the total channel length according to the chart in Appendix 1 at the end of this section.
 - d. Or Owner approved equal.

 3. Leviton, Category 6A, shielded cord (use same cord for shielded or unshielded systems) 4-pair, stranded wire construction.
 - a. Color: Green.
 - b. Part Numbers:
 - 1) Leviton 6AS10-07G (7 feet, Green). For voice/data applications at user end.
 - 2) Leviton 6AS10-10G (10 feet, Green). For voice/data applications at user end.
 - 3) Leviton 6AS10-15G (15 feet, Green). For voice/data applications at user end.
 - c. Or Owner approved equal.

 4. Leviton, Category 6A, shielded cord (use same cord for shielded or unshielded systems) 4-pair, stranded wire construction.
 - d. Color: Yellow.
 - e. Part Numbers:
 - 1) Leviton 6AS10-07Y (7 feet, Yellow). For Wireless/AP applications at user end.
 - 2) Leviton 6AS10-10Y (10 feet, Yellow). For Wireless/AP applications at user end.
 - 3) Leviton 6AS10-15Y (15 feet, Yellow). For Wireless/AP applications at user end.
 - f. Or Owner approved equal.
- D. Cat 6A Patch Panels:
1. Leviton Cat 6A Flat 110-Style Patch Panel, 1RU, 24-Port, with 1 cable management bar.
 - a. Part Number: Leviton 6A586-U24.
 2. Leviton Cat 6A Flat 110-Style Patch Panel, 2RU, 48-Port, with 2 cable management bars.
 - a. Part Number: Leviton 6A586-U48.
 - b. Or Owner approved equal.
- E. Cable Management Clip:

1. Cable management clip, gray.
 - a. Part Number: Leviton 49005-CMC.
 - b. For cable management on the rear of every patch panel.
 - c. 1RU patch panels require 1 cable management clip.
 - d. 2RU patch panels require 2 cable management clips.
 - e. Or Owner approved equal.

- F. Flush-Mounted Stainless-Steel Faceplates:
 1. 1-port QuickPort single-gang stainless steel wall plate, with ID windows
 - a. Part Number: Leviton 43080-1L1.
 2. 2-port QuickPort single-gang stainless steel wall plate, with ID windows
 - a. Part Number: Leviton 43080-1L2.
 3. 4-port QuickPort single-gang stainless steel wall plate, with ID windows
 - a. Part Number: Leviton 43080-1L4.
 4. 6-port QuickPort single-gang stainless steel wall plate, with ID windows
 - a. Part Number: Leviton 43080-1L6.
 5. 4-port QuickPort dual-gang stainless steel wall plate, with ID windows
 - a. Part Number: Leviton 43080-2L4.
 6. 8-port QuickPort dual-gang stainless steel wall plate, with ID windows
 - a. Part Number: Leviton 43080-2L8.

2.14 STATION CABLING – WIRELESS ACCESS POINTS

- A. Category 6A Unshielded Twisted Pair:
 1. 100-ohm, Category 6A, 23 AWG, 4-pair unshielded twisted pair, LM-RDT, CMP rated.
 - a. Color: Green. For Voice/Data Applications.
 - b. Part Numbers: Reel: 11142235
 - c. Maximum Cable Diameter: 0.300 inch.
 - d. Berk-Tek LM-RDT CMP
 - e. Or Owner approved equal.

- B. Category 6A Modular Jacks:
 1. Leviton 8-position eXtreme QuickPort modular jack, Category 6A, IDC terminals, T568A/B wiring scheme.
 - a. Color: green.
 - b. Each Connector: Identified on its face as CAT 6A.
 - c. Part Number: Leviton 6110G-RV6 (green). For Voice/Data Applications.
 - d. Or Owner approved equal.

- C. In-Ceiling Bracket:
 1. In-Ceiling Bracket, with clip for drop wire/rod mounting.
 - a. Part Number: Leviton 49223-CBC. For wireless applications.
 - b. Brackets must be installed on a dedicated drop wire/rod per NEC® 300.11
 - c. Compatible with QuickPort Surface-Mount Boxes (fasteners included with bracket, boxes sold separately)

- D. Surface Mount Box:
 1. Surface Mount Box, 1-port, standard depth.

- a. Color: white.
 - b. Part Number: Leviton 41089-1WP. For wireless applications.
 - c. Brackets must be installed on a dedicated drop wire/rod per NEC® 300.11
 - d. Compatible with QuickPort Surface-Mount Boxes (fasteners included with bracket, boxes sold separately)
- E. Cat 6A Patch Panels:
1. Leviton Cat 6A Flat 110-Style Patch Panel, 1RU, 24-Port, with 1 cable management bar.
 - a. Part Number: Leviton 6A586-U24.
 2. Leviton Cat 6A Flat 110-Style Patch Panel, 2RU, 48-Port, with 2 cable management bars.
 - a. Part Number: Leviton 6A586-U48.
 - b. Or Owner approved equal.
- F. Cable Management Clip:
2. Cable management clip, gray.
 - a. Part Number: Leviton 49005-CMC.
 - b. For cable management on the rear of every patch panel.
 - c. 1RU patch panels require 1 cable management clip.
 - d. 2RU patch panels require 2 cable management clips.
- G. OM3, aqua. Factory-terminated, double-ended, 2-strand multimode cordage. Use for OM3 Fiber Optic System
- a. 50/125 μ m LOMM (OM3) OFNR
 - b. Duplex LC-Duplex LC:
 - 1) Part Number: Leviton 5LDLC-M01 (1 meter)
 - 2) Part Number: Leviton 5LDLC-M02 (2 meter)
 - 3) Part Number: Leviton 5LDLC-M03 (3 meter)
- A. Firestop Sealants: STI SpecSeal® Brand single component latex formulations that upon cure do not re-emulsify during exposure to moisture, the following products are acceptable:
1. Specified Technologies Inc. (STI) SpecSeal® Series SSS Sealant
 2. Specified Technologies Inc. (STI) SpecSeal® Series LCI Sealant
- B. Firestop Putty: STI SpecSeal® Brand intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds, the following products are acceptable:
1. Specified Technologies Inc. (STI) SpecSeal® Series SSP Putty
- C. Firestop Pillows: STI SpecSeal® Brand re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag, the following products are acceptable:
1. Specified Technologies Inc. (STI) SpecSeal® Series SSB Pillows
- D. Fire-Rated Cable Grommet: STI SpecSeal® Brand Firestop Grommet is a molded, two-piece grommet with an integral fire and smoke sealing foam membrane for sealing individual cable penetrations through framed wall assemblies. Grommet snaps together around cable and locks tightly into the wall.
1. Specified Technologies Inc. (STI) SpecSeal® Brand Ready® Firestop Grommets; RFG1.

- E. Fire-Rated Cable Pathways: STI EZ-PATH® Fire-Rated Pathway device modules comprised of steel pathway with self-adjusting intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) EZ-PATH® Fire Rated Pathway
- F. Smoke and Acoustical Pathways: STI EZ-PATH® Smoke & Acoustical Pathway device module comprised of a nonmetallic pathway with integral self-adjusting smoke and sound sealing system for cable penetrations through non-fire-resistance rated wall or floor assemblies, the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) EZ-PATH® Smoke & Acoustical Pathway; Model No. NEZ33.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive communications horizontal cabling.
- B. Notify Architect of conditions that would adversely affect installation or subsequent use.
- C. Do not begin installation until unacceptable conditions are corrected.

3.2 INSTALLATION – GENERAL

- A. Install communications horizontal cabling in accordance with manufacturer's instructions, ANSI/TIA-568-D.0, ANSI/TIA-568-D.1, ANSI/TIA-569-D, BICSI TDMM, and NFPA 70.
- B. Field Terminated Copper and Fiber Optic Patch Cords and Jumpers: Not allowed.
- C. Copper Patch Cords and Fiber Jumpers: Manufactured by Leviton Network Solutions.
- D. Install cables after building interior has been physically protected from weather and mechanical work likely to damage cabling has been completed.
- E. Ensure cable pathways are completely and thoroughly cleaned before installing cabling.
- F. Inspect installed conduit, wireway, cable trays, and innerduct.
- G. Clean additional enclosed raceway and innerduct systems furnished.
- H. Provide protection for exposed cables where subject to damage.
- I. Abrasion Protection:
 - 1. Provide abrasion protection for cable or wire bundles which pass through holes or across edges of sheet metal.
 - 2. Use protective bushings to protect cables.
- J. Cable Ties and Other Cable Management Clamps:
 - 1. No more than hand tightened.
 - 2. Fit snugly, but not compress, crimp, or otherwise change physical characteristics of cable jacket or distort placement of twisted-pair components.
 - 3. Replace cables exhibiting stresses due to over tightening of cable management devices.
 - 4. Velcro wraps are required for all cable bundles. Plastic cable ties are strictly prohibited.
- K. Where possible, route cables in overhead cable trays and inside wire management systems attached to equipment cabinets and racks.
 - 1. Use Velcro or ducts to restrain cabling installed outside of wire management systems on racks or in cabinets.
 - 2. Cable Trays: Do not exceed 50 percent fill.
- L. Pull Cord:
 - 1. Nylon, 1/8-inch minimum.
 - 2. Co-install with cables installed in conduit.
- M. Cable Raceways: Do not fill greater than ANSI/TIA-569-D maximum fill ratio for each raceway type.

- N. Support horizontal cables at a maximum of 48-inch (1.2 to 1.5-m) irregular intervals if J-hook or trapeze system is used to support cable bundles.
- O. Do not allow cables to rest on acoustic ceiling grids, plumbing pipes, or electrical conduits.
- P. Bundle horizontal distribution cables in groups of no more than number of cables designed for by cable support manufacturer, based on cable OD and weight.
- Q. Fire-Sprinkler System:
 - 1. Install cables above fire-sprinkler system.
 - 2. Do not attach cables to fire-sprinkler system or ancillary equipment or hardware.
 - 3. Install cable system and support hardware so that it does not obscure valves, fire alarm conduit, boxes, or other control devices.
- R. Do not attach cables to ceiling grid or lighting fixture wires.
- S. Install appropriate carriers to support cabling, where support for horizontal cables are required.
- T. Replace before final acceptance, cables damaged or exceeding recommended installation parameters during installation.

3.3 INSTALLATION – UNSHIELDED TWISTED-PAIR CABLES

- A. Install unshielded twisted-pair cables in accordance with manufacturer's instructions.
- B. Install cables in continuous lengths from origin to destination, without splices, except for transition points or consolidation points.
- C. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in enclosure intended and suitable for the purpose.
- D. Cable Minimum Bend Radius and Maximum Pulling Tension:
 - 1. Do not exceed bend radius for UTP = 4 X Cable OD, FTP = 4 X Cable OD.
 - 2. Install unshielded twisted-pair cables so that there are no bends smaller than 4 times cable outside diameter at any point in the run and at the termination field.
 - 3. Pulling Tension on 4-Pair UTP Cables: Do not exceed 25 ft.lb. for 4-pair UTP cable.
- E. Separation from Power Lines: Provide following minimum separation distances between pathways for copper communications cables and power wiring of 480 volts or less:
 - 1. Open or Nonmetal Communications Pathways:
 - a. Electric motors, fluorescent light fixtures, and unshielded power lines carrying up to 3 kVA: 12 inches.
 - b. Electrical equipment and unshielded power lines carrying more than 5 kVA: 36 inches.
 - c. Large electrical motors or transformers: 48 inches.
 - 2. Grounded Metal Conduit Communications Pathways:
 - a. Electrical equipment and unshielded power lines carrying up to 2 kVA: 2-1/2 inches.
 - b. Electrical equipment and unshielded power lines carrying from 2 kVA to 5 kVA: 6 inches.
 - c. Electrical equipment and unshielded power lines carrying more than 5 kVA: 12 inches.
 - d. Power lines enclosed in grounded metal conduit (or equivalent shielding) carrying from 2 kVA to 5 kVA: 3 inches.
 - e. Power lines enclosed in grounded metal conduit (or equivalent shielding) carrying more than 5 kVA: 6 inches.

3.4 INSTALLATION – UNSHIELDED TWISTED-PAIR TERMINATION

- A. Coil cables to house cable coil without exceeding manufacturer's bend radius.
 - 1. In hollow wall installations where box eliminators are used, store excess wire in wall.
 - 2. Store no more than 12 inches of UTP and 36 inches of fiber slack.
 - 3. Loosely coil excess slack and store in ceiling above each drop location when there is not enough space present in outlet box to store slack cables.

- B. Dress and terminate cables in accordance with ANSI/TIA-568-D.0, ANSI/TIA-D.1, BICSI TDMM, and manufacturer's instructions.
- C. Terminate 4-pair cables on jack and patch panels using T568-B or T568-A wiring scheme.
- D. Pair Untwist at Termination: Do not exceed 12.7 mm (1/2 inch) for Cat 6 and 6.4 mm (1/4 inch) for Cat 6A.
- E. Bend Radius of Horizontal Cables:
 - 1. Not less than 4 times OD of UTP cables.
- F. Maintain cable jacket to within 12.7 mm (1/2 inch) of termination point.
- G. Neatly bundle cables and dress to their respective panels or blocks.
 - 1. Feed each panel or block by individual bundle separated and dressed back to point of cable entrance into rack or frame.

3.5 INSTALLATION – RACK ELEVATION AND PATCH PANEL INSTALLATION

- A. **In each IDF/MDF the cables will be installed on the patch panels by the use of the cable. The reasoning behind this is to assist in improving security on the switch side, more effective cable management, and align cabling with switches for better device management.**
 - 1. **Smart-TV cables sequentially align on the same patch panel (Leave 4 open ports for growth)**
 - 2. **Clock cables will sequentially align on the same patch panel (Leave 4 open ports for growth)**
 - 3. **Security camera and Alarm cables will sequentially align on the same patch panel (Leave 4 open ports for growth)**
 - 4. **WAP device cables will sequentially align on the same patch panel (Leave 4 open ports for growth)**
 - 5. **Teacher drop cables will sequentially align on the same patch panel (Leave 4 open ports for growth)**
 - 6. **Student drop cables will sequentially align on the same panel (Leave 4 open ports for growth)**
- B. **Patch panels will be placed into the following order**
 - 1. **24 port patch panel at the top**
 - 2. **Leave a space for 48 port Switch**
 - 3. **48 port patch panel**
 - 4. **Leave a space for 48 port Switch**
 - 5. **Repeat till end with 24 port patch panel at the bottom**
 - 6. **In the middle of this layout of patch panel and switch put a 1U cable management rack**
- C. **Note: The IDF on the second floor in area D will have cables from both floors pulled to it. The first-floor cabling will be terminated in one rack and the second floor cabling in another.**

3.6 INSTALLATION – OPTICAL FIBER CABLES

- A. Place fiber optic cables to maintain minimum cable bend radius limits specified by manufacturer or 15 times cable diameter, whichever is larger.
- B. Use care when handling fiber optic cables.
 - 1. Carefully monitor pulling tension so as not to exceed limits specified by manufacturer.
- C. Do not splice horizontal fiber optic cables.

3.7 FIELD QUALITY CONTROL

- A. Cables and Termination Hardware: Test 100 percent for defects in installation and verify cabling system performance under installed conditions in accordance with ANSI/TIA-568-D.0.

1. Verify all pairs of each installed cable before system acceptance.
2. Defects in cabling system installation, including but not limited to cables, connectors, patch panels, and connector blocks shall be repaired or replaced to ensure 100 percent useable conductors in all cables installed.
- B. Test all cables in accordance with this specification section, ANSI/TIA-568-D.2, and ANSI/TIA-568-D.3 standards, and Berk-Tek Leviton Technologies instructions.
 1. If any of these are in conflict, bring discrepancies to the attention of the Architect for clarification and resolution.
- C. Cables, Jacks, Connecting Blocks, and Patch Panels:
 1. Verify all pairs of each installed cable before system acceptance.
 2. Defects in cabling system installation, including but not limited to cables, connectors, patch panels, and connector blocks shall be repaired or replaced to ensure 100 percent useable conductors in all cables installed.
- D. Testing Unshielded Twisted-Pair Cables: **(NOTE: Permanent Link Test results are recommended and are the expected norm.)**
 1. Test twisted-pair copper cable links for continuity, pair reversals, shorts, opens, and performance as specified.
 - a. Additional testing is required to verify Category performance.
 - b. Test horizontal cabling using approved certification tester for Category 6A performance compliance in accordance with ANSI/TIA-568-D.2.
(NOTE: Appropriate Fluke, Agilent, Ideal, or JDSU certification testers may be used).
 - c. Category 6A shall conform to ANSI/TIA-568-D.2 for augmented Category 6 to 500 MHz.
 2. Follow ANSI/TIA-568-D.2.
 3. Basic Tests Required:
 - a. Wire map.
 - b. Length (feet).
 - c. Insertion loss (dB), formerly attenuation.
 - d. NEXT (Near end crosstalk) (dB).
 - e. Return loss (dB).
 - f. ELFEXT (dB).
 - g. Propagation delay (ns).
 - h. Delay skew (ns).
 - i. PSNEXT (Power sum near-end crosstalk loss) (dB).
 - j. PSELFEXT (Power sum equal level far-end crosstalk loss) (dB).
 4. Test Category 6A by auto test to 500 MHz.
 - a. Alien Crosstalk (AXT) testing and AXT test results are NOT required by Berk-Tek Leviton Technologies for warranty of a Category 6A system. **(Note:** AXT testing may be required by the customer, in which case these tests WOULD have to be performed).
 5. Test Category 6 by auto test to 250 MHz.
 6. Test Category 5e by auto test to 100 MHz.
 7. Provide test results in approved certification testers original software format on CD, with the following minimum information per cable:
 - a. Circuit ID.
 - b. Information from specified basic tests required.
 - c. Test Result: "Pass" or "Fail".
 - d. Date and time of test.
 - e. Project name.
 - f. NVP.
 - g. Software version.
 8. An occasional asterisk-Pass (*Pass) will be accepted by Berk-Tek Leviton Technologies at the manufacturer's discretion, but rework of these links should be done to achieve clean "Pass" results prior to submission of test results.

9. To receive Manufacturer's Warranty for the project, submit software copy of test results, in original tester software format, to the Owner and to the Manufacturer (Leviton Network Solutions).
 10. Submit fully functional version of tester software for use by the Owner in reviewing test results.
 11. Report in writing to the Owner immediately, along with copy of test results, failed test results that cannot be remedied through re-termination (as in the case of reversed or split pairs).
- E. Optical Fiber:
1. Testing procedures shall be in accordance with the following:
 - a. ANSI/TIA-568-D.3
 - b. ANSI/TIA-526-7
 - c. TIA TSB-140
 - d. Encircled Flux testing per the TSB-4979 and TIA-526-14-C standard.
 2. Test Equipment: Certification tester (Note: Fluke or Agilent testers may be used).
 3. Testing:
 - a. Test optical fibers at both 850 nm and 1300 nm wavelengths for multimode, 1310 nm and 1550 nm wavelengths for singlemode, end-to-end insertion loss, Telecommunications Room (TR) to Telecommunications Outlet (TO), Telecommunications Outlet (TO) to Telecommunications Room (TR).
 - b. Maximum insertion loss for horizontal fiber optic cables without consolidation point: 2.0 dB.
 - c. Test horizontal fiber runs TR to TO, TO to TR, at wavelength of operation to desktop applications.
 4. Submit software copy of test results, in original tester software format, to the Owner and to the Manufacturer (Leviton Network Solutions).

3.8 LABELING

- A. Self-laminating or wrap-around style labels shall be used for horizontal cabling.
- B. All labeling is to be in accordance with ANSI/TIA-606-C and manufacturer's instructions.
- C. Label horizontal cables using machine-printed label at each end of cable at approximately 12 inches from termination point and again at approximately 48 inches from termination point.
 1. Handwritten Labels: Not acceptable.
- D. Label patch panel ports and TO ports with cable identifier.
- E. Labels:
 1. Owner may provide specific labeling requirements. Coordinate with the Owner.
- F. Note labeling information on as-built drawings.
- G. Typical Patch Panel Labeling
- H. Typical Wallplate Labeling

3.9 PROTECTION

- A. Protect installed communications horizontal cabling from damage during construction.

END OF SECTION 27 10 00

SECTION 27 41 13

VIDEO WALL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provide all equipment specified well as all miscellaneous parts and materials required for the proper installation of the Audio/Visual system. Any alternates must be approved in writing by architect and maintenance.
- B. All applicable equipment shall bear the UL label.
- C. Contractor shall have been in the professional pro-audio business for at least five or more years. Contractor shall have installed at least five or more equivalent systems within the county areas.
- D. Integrate the local sound reinforcement system with the following systems:
 - 1. Local Area and College Wide Network – data drop by Technology cabling contractor & switch configuration to be coordinated with College IT department.
 - 2. Fire alarm system – Fire alarm Module and Wiring by Fire alarm Contractor.
- E. Refer to Section Div 26 for raceway specification and general requirements.
- F. Provide 6-strand, OM4 Multi-Mode Fiber route back to MDF rack for network connection.
- G. Electrician shall be responsible for all raceway and conduit and will coordinate with sound contractor prior to installation.
- H. Electrician shall provide (2) dedicated 20-amp 120-volt circuits with ground to AV Rack housed in a quad enclosure with circuits divided to either side of 1-gang outlets.
- I. Systems to be installed in the following Area(s):
 - 1. Front Lobby Video Walls

1.2 SUBMITTALS

- A. Certificates:
 - 1. Contractor shall hold and maintain manufacturer's certification for the audiovisual system.
 - 2. The contractor must be certified with the manufacturer for the audiovisual system for at least twelve (12) months prior to bid.
 - 3. The Contractor shall provide proof of certification to the College.
- B. Qualification Statements:
 - 1. Provide Contractor's experience and qualifications, which shall include three (3) years of projects of similar complexity. Include names and locations of two projects successfully completed using an instructional classroom technology.
 - 2. Provide documentation indicating Contractor has been in the telecommunications contracting business for a minimum of five (5) years under the same name and is located within two hundred (200) miles of the College.

VIDEO WALL SYSTEMS

- C. Equipment Schedule:
 - 1. Prior to ordering materials or commencing any construction activities, the Integrator shall provide the Owner with a complete bill of materials, including all quantities of components, devices, equipment, and wiring required to complete this work.
- D. Product Data:
 - 1. Submit product data, including manufacturer's data sheets, for all proposed system components.
 - 2. Provide a list of complete part numbers and confirm with College during submittal phase.
 - 3. Contractor and Integrator shall verify all equipment models, correct components, and correct amounts of components.
 - 4. If additional equipment is required to meet performance specifications of the system, the contractor shall provide the equipment with written College approval prior to installation.
- E. Refer to **Section 01 33 00: Submittal Procedures** for additional requirements.

1.3 OPERATING AND MAINTENANCE MANUALS

- F. Documentation to be submitted upon completion of system are:
 - 1. Upon completion of installation, the contractor shall prepare "as-built" drawings of the system. As-built shall be of each floor plan indicating exact device locations, panels, cable routes and wire numbers as tagged on faceplates and headend.
 - 2. Maintenance required and maintenance schedule.
 - 3. Provide a list of MLC devices, IP addresses, MAC addresses, serial numbers, and locations.
 - 4. Documentation of the completed system shall be submitted in both hard and soft copy. Soft copy shall be submitted in Adobe PDF format.
 - 5. Contractor shall gather and provide all non-waste items to the College.
 - 6. An "As Built" block diagram of the system showing how the components are connected and where each is located.
 - 7. Wiring diagram for equipment including point-to-point circuit diagrams.
 - 8. Color code of conductors.
 - 9. Provide Operating and Maintenance Manuals as specified in Div 26 and Division One.

1.2 WARRANTY

- A. The Contractor shall provide manufacturer's warranty that any equipment installed under this specification shall be free from defect for a period of five (5) years from the date of final acceptance.
- B. The Contractor shall warrant the workmanship and installation of the system for one (1) year. If issues relating to workmanship or system configuration are discovered post commissioning Contractor will come out onsite to correct these issues at no cost during the warranty period.
- C. During the warranty period, the Contractor shall provide the College with the manufacturer's toll-free hotline and support center to assist the College to service the specified product.

- D. During the warranty period, the Contractor shall maintain adequate stock of potential replacement parts to service the system should component failure occur.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
B. Repair or replace damaged components before Substantial Completion of the project.
C. ALL excess material that comes with the system shall be turned over to College Representative at the conclusion of work. This includes unused button stencils, tweakers (Extron screwdrivers), faceplates and unused input labels.

PART 2 – MATERIALS

2.1 OUTDOOR COURTYARD CLASSROOM/STAGE

A. ABSEN LED WALL

1. Video Wall shall be manufactured by Absen and contain all but not limited to the following items:
 - 1) C6604-1-02 – A0421(1280mm x 640mm) x32
 - a) Pixel Pitch: 4.44mm; Dimension (WxHxD): 50.4x25.2x2.76 in; Weight: 45.6 lbs/panel; Brightness: 7500 nits; Color Depth: 16 bits; Contrast Ratio: 7500:1; Power Consumption: 466.9 W/panel; Ip rating: IP65/IP54; Front Serviceable; Certification: FCC+ETL.
 - 2) C6604-1-04 – A0421 (960mm x 640) x12
 - a) Pixel Pitch: 4.44mm; Dimension (WxHxD): 37.8x25.2x2.76 in; Weight: 39.6 lbs/panel; Brightness: 7500 nits; Color Depth: 16 bits; Contrast Ratio: 7500:1; Power Consumption: 350 W/panel; Ip rating: IP65/IP54; Front Serviceable; Certification: FCC+ETL.
 - 3) C6604-1-05 – A0421 (640mm x 640mm) x12
 - a) Pixel Pitch: 4.44mm; Dimension (WxHxD): 25.2x25.2x2.76 in; Weight: 23 lbs/panel; Brightness: 7500 nits; Color Depth: 16 bits; Contrast Ratio: 7500:1; Power Consumption: 233.5 W/panel; Ip rating: IP65/IP54; Front Serviceable; Certification: FCC+ETL.
 - 4) C6600-0-01 Receiver Card HUB-A 2022A x2.
 - 5) C6600-0-02 HUB-B – New A HUB 2020B x2
 - 6) C6604-0-01 A0421 left module – 320x320 mm x8.
 - 7) C6604-0-02 A0421 right module – 320 x 320 mm x8.
 - 8) C6600-0-04 A21 Series Power Supply – 450W for 640mm high panel x2.
 - 9) C6600-0-08 HUB-D – New A HUB 2020D x2
 - 10) C6600-0-07 Receiver Card HUB 2020C x2.
 - 11) C6600-0-03 A21 Series Power Supply – 400W for 960mm high panel x2.
 - 12) C6600-0-05 New A Series Main Power Cable, 10m x10.
 - 13) C6600-0-06 New A Series Main Power Cable, 20m x8.
 - 14) D8600-0-00 Free Spare Parts – Free 3% spare parts including Modules, Receiving cards, Power Supply and HUB x1.
 - 15) F8100-0-07 A5s Plus – Receiving card x2.

VIDEO WALL SYSTEMS

- 16) F800-0-68 VX600 – Nova Video Processor x 2
 - 17) F8000-0-08 10G SFP Module Single Mode x4.
 - 18) F8000-0-20 CVT10-S – Single Mode optical fiber converter x2.
 - 19) E9000-0-27 Installation Support Package 1 Tech x 1.
 - 20) One Video Wall to have Fiber Capabilities since it's out of reach.
2. There will be 2 Video Walls in the shape of Trapezoids. Mirror to each other.
 3. The contractor will provide all required Fiber or Data cabling back to VX15S for proper image rendering, rigging support hardware to accommodate a stable structure to withstand weather elements against LED Wall, and shall abide by local governance and state codes. Coordinate with Electrical contractor to ensure installation of proper power according to equipment requirements for proper usage and longevity.
 4. Mount for the Video Wall to be manufactured by Draper.

B. NETWORK SWITCH

1. Contractor shall provide a college approved model of network switch that is PoE++ rated, provides adequate data ports and wattage that will be routed via fiber over SFP communication to MDF.

SCREEN SPECIFICATION PER SCREEN*:	
Product:	A0421 (4.44 mm)
Dimension (WxH):	8.000 m x 2.560 m = 20.48 sqm 26.25 ft x 8.40 ft = 220.50 sqft
Diagonal:	8.4 m / 330.69 in / 27.56 ft
Aspect Ratio (WxH):	3.125 : 1
Weight:	486 kg / 1071 lbs
Resolution (WxH):	1800 x 576
Panels Matrix (WxH):	4 x 4(1280mm x 640mm) , 3 x 2(960mm x 640mm) , 3 x 2(640mm x 640mm)
Panels Per Screen:	28
Total Screen:	2
Primary Data Runs Required:	2 , 1 , 1
Max Panels of Data Cascade:	13 , 18 , 27
Max Power Requirement:	10973 W
Heat Load:	26209 BTU/hr
AC Main Power Cables Required:	3 , 1 , 1 @208V/16A OR 6 , 2 , 1 @110V/16A
AC Circuit Single Outlet Required:	5 @208V/20A Circuits OR 9 @110V/20A Circuits
Max Panels Of Power Cascade:	7 , 9 , 14 @208V OR 3 , 5 , 7 @110V

C.

PART 3 – EXECUTION

3.1 WIRING AND INSTALLATION TECHNIQUES

- A. Coordinate all work with all other trades to avoid causing delays in construction schedule. Contractor shall expedite the delivery of materials and provide additional labor as required to meet construction deadline.
- B. Coordinate final connection of power and ground wiring to equipment racks by electrical contractor. Power and ground wiring shall terminate inside equipment racks on a standard duplex outlet. Mount as to not interfere with internal equipment of the rack. Power shall be a dedicated circuit and not share with any other source. Ground as per NEC with third wire (green) to panel ground lug at breaker supply panel.
- C. All equipment and enclosures described in this specification section shall be plumb and square. All equipment except portable equipment, shall be permanently attached to the structure and held firmly in place. Supports shall be adequate to support their loads with a safety factor of at least three.

- D. Wiring and installation under this contract to meet NFPA, NEC, and local code requirements where applicable.
- E. The process of equalizing and testing the Audio Sound System may necessitate moving and adjusting certain component parts (e.g., loudspeakers). This shall be done without claim for additional payment.
- F. Take such precautions as are necessary to prevent and guard against electromagnetic and electrostatic hum. Separate all low level microphone and auxiliary inputs from speaker output conductors, data or other system wiring.
- G. All wiring shall be labeled as to destination using vinyl wire labeling tags. Use I wire labeling printer. Label input, output and wireless wiring. Label electrical power breaker at electrical panel. Label location of room and power panel/breaker at equipment rack.
- H. Label all mixer inputs with their respective location. Example: mixer input 1 - Mic 1 etc. Name to reflect name on engraved wall plate.
- I. Paint all back boxes and conduit prior to installation of wiring or connectors. Protect and do not paint any wiring or equipment rack cabinets.
- J. Install equipment cabinet in a controlled temp, dry and accessible area. Provide space to open cabinet completely. Equipment not to be in general gym area where it can be damaged.
- K. Mount wireless antenna on side of pilasters as shown in drawings. Mount/locate at least 12' A.F.F. in order to prevent tampering.

PART 4 - INSPECTIONS/CLOSEOUT ACTIVITIES

4.1 GENERAL

- A. Conformance to the installation practices covered above is to be verified when completed. In some cases, the Owner/ Designer may inspect before acceptance.
- B. Adjust speaker volumes to provide clear, uniform sound coverage throughout courtyard through entire volume range of amplifier, provide limiter circuit and controls on amplifier to prevent overdriving or clipping the speaker system.
- C. Contractor shall use white noise generator and spectrum audio analyzer to set overall frequency response and equalization Limiter(s) shall be set to prevent damage to amplifier and speakers. Amplifier to be set to prevent overdriving from pre-amp.
- D. Demonstrate the performance of the system and give instructions of proper operation and maintenance to the Owner. Provide 2 hrs. Of training and laminated copy of basic system operating instructions and affixed to the inside of the rack door with appropriate mounting hardware.

4.2 CABLING

- A. Provide the following cable types for the following functions:
 - 1. Category 6 cable for media devices
 - 2. One pair #14 AWG twisted to sound reinforcement speakers
 - 3. RG-58U for wireless mic antenna

PART 5 - CLOSEOUT ACTIVITIES

5.1 Training

- A. Demonstrate the performance of the system and give instructions of proper operation and maintenance to the Owner. Provide 2 hrs. Of training and laminated copy of basic system operating instructions and affixed to the inside of the rack door with appropriate mounting hardware.
- B. Initial Training will cover the use of the AMX-Based Audiovisual System. In addition, Contractor is required in initial training to provide instruction to College personnel on all 'outdoor classroom' AV functionality to ensure that the college can power up and down the Video Wall, utilize HDMI inputs, utilize audio inputs zones, turn on wireless microphones, control volume, change scenes, switch between all classroom media equipment, and provide training for intended functions to administrative staff, College IT staff, and any other staff whom the college deems appropriate to receive such training.
 - 1. Initial Training will also cover the use of Camera and streaming system. In addition, Contractor is required in initial training to provide instruction to College personnel on voice amplification system start up, charging and volume control.

END OF SECTION

SECTION 27 41 16 - INTEGRATED AUDIO/VIDEO SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Integrated Audio-Video Systems and Equipment as part of the Work.

1.2 RELATED DOCUMENTS

- A. General provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this section.
- B. Reference the Project Manual for related specification sections.
- C. Reference the Project Drawings for additional information.

1.3 SECTION INCLUDES

- A. Project instructions for the Contractor and System description details
- B. System product description
- C. Project completion instructions for the Contractor

1.4 RESPONSIBILITY

- A. Responsibilities include, but are not limited to, the following items:
 - 1. Provide materials, equipment, transportation, and labor necessary for a fully working, tested, and calibrated system. Supply accessories and minor equipment items (such as, but not limited to, power strips, adapters, connectors, mounting hardware, etc.) needed for a complete system, even if not specifically mentioned in these Specifications. Notify the Architect of any discrepancies in part numbers or quantities before bid. Failing to provide such notification, supply items and quantities according to the intent of the Specification and Drawings, without claim for additional payment.
 - 2. Specifications and drawings are complementary. Work called for by one is binding as if called for by both. Any discrepancies between specifications and drawings shall be brought to the attention of the Architect for clarification during the bidding period. No allowance shall subsequently be made to the Contractor by reason of their failure to have brought said discrepancies to the attention of the Architect.
 - 3. Execute work in accordance with the National Electrical Code (NEC), the National Electrical Safety Code, the Occupational Safety and Health Act (OSHA), applicable State and Local codes, ordinances, regulations, authority having jurisdiction (AHJ), and manufacturer's recommendations. If a conflict develops between the contract documents and the appropriate codes and is reported to the Architect prior to bid opening, the Architect will prepare the necessary clarification. Where a conflict is reported after contract award, propose a resolution of the conflict and, upon approval, perform Work.
 - 4. Required licenses, insurance and permits including payment of charges and fees
 - 5. Verification of dimensions and conditions at the job site.
 - 6. Coordinate location and installation of equipment with other building elements.
 - 7. Preparation of submittal information
 - 8. Pick-up of Owner Furnished Equipment (OFE) and incorporation into project if applicable.

9. Development and implementation of control system software code and control panel layouts, which will become the property of the Owner
10. Final tests and adjustments, written report, and documentation
11. Instruction of operating personnel
12. Provision of manuals
13. Maintenance services and warranty.

1.5 REFERENCES

- A. Published specification standards, tests or recommended methods of trade, industry or governmental organizations apply to Work in this section where cited below:
 1. American National Safety Institute (ANSI)
 2. American Society of Testing and Materials (ASTM)
 3. Electronics Industries Association (EIA)
 4. Federal Communications Commission (FCC)
 5. National Electrical Manufacturer's Association (NEMA)
 6. National Electrical Code (NEC)
 7. Underwriters Laboratories (UL)
 8. Occupational Safety and Health Administration (OSHA)
 9. Society of Motion Picture and Television Engineers (SMPTE)
 10. Building Industry Consulting Service International (BICSI)
 11. Davis and Davis, Sound System Engineering (3rd Edition) (SSE), Howard W. Sams, 2006
 12. Giddings, Audio System Design and Installation (ASDI), Howard W. Sams, 2013
 13. AV Installation Handbook Second Edition: The Best Practices for Quality Audiovisual Systems, Infocomm (AVIH), 2009

1.6 DEFINITIONS

- A. In addition to those Definitions of Division 1, the following list of terms as used in this specification shall be defined as follows:
 1. Furnish - To purchase, procure, acquire, and deliver complete with related accessories.
 2. Install – To set in place, join, attach, link, set up or otherwise connect together and test until complete before turning over to the Owner, all parts, items, or equipment supplied by Contractor.
 3. Provide – To furnish and install.

1.7 DESCRIPTIONS & REQUIREMENTS

- A. The following is intended to further describe the Work and clarify design intent and is not an exhaustive description of the systems.
- B. Black Box
 1. General
 - a. Equipment Housing
 - 1) Provide a portable equipment rack for housing a mixer, wireless microphone system, and playback equipment.
 - 2) Provide a permanent free-standing rack in a designated room for housing amplifiers and other processing equipment.
 2. Audio System
 - a. Audio Sources
 - 1) Provide an assortment of dynamic microphones.
 - 2) Provide a wireless microphone system.
 - 3) Provide a rack-mounted multi-media player for music playback.
 - 4) Provide wired and wireless media connectivity.
 - 5) Provide cabling and equipment accessories.

- b. Mixing System
 - 1) Provide a rack-mounted digital mixer.
 - c. Processing and Amplification
 - 1) Provide DSP amplification for room loudspeakers.
 - d. Loudspeakers
 - 1) Provide loose loudspeakers with pipe clamps for mounting to the pipe grid.
 - 2) Provide loudspeakers distributed throughout the lobby.
 - 3) Provide loudspeakers distributed throughout the back-of-house corridors.
 - 4) Provide loudspeakers in talent spaces, including dressing rooms and shops.
 - e. Production Intercom
 - 1) Provide an analog production party line system.
 - 2) Provide wired connections throughout the space, including the control room and catwalk.
 - 3) Provide connection to flush-mounted speaker stations in talent spaces and shops.
 - f. Hearing Assist
 - 1) Provide a wireless, single-channel radio frequency hearing assist system.
 - 2) The system must operate on approved FCC frequencies.
 - 3) Provide enough portable receivers to meet current ADA standards, including:
 - a) Ear speakers
 - b) Headsets
 - c) Inductive coil loops
3. AV Systems
- a. Control
 - 1) Provide touch panel controllers in the Black Box and Control Booth
 - 2) Provide a room control system in the equipment rack
 - b. Video
 - 1) Provide a video projector
 - 2) Provide a drop-down projection screen
 - 3) Provide two displays in the Control Booth
 - 4) Provide HDMI input plates in Black box and control booth
 - 5) Provide a Wireless Presentation System
 - 6) Provide an HDMI output at the control booth.
 - 7) Provide HDMI splitter, HDMI cables, and small monitors that can be set up for video at each station in booth if desired
 - c. Cameras
 - 1) Provide Pan-Tilt-Zoom cameras at each of the sides of the room
- C. Lobby
- 1. AV System
 - a. Provide a button panel control
 - b. Provide an HDMI Input
 - c. Provide a monitor with a view to the corridor
 - d. Provide a web-based digital media player mounted behind the monitor.
- D. Green Room
- 1. AV System
 - a. Provide a Monitor
 - b. Provide a touchpanel controller
 - c. Provide a Floor Box with an HDMI Input located under the table
 - d. Provide a Video/Soundbar with a Camera, Microphone, and Speaker mounted below the display
 - e. Provide USB port at the table for soundbar connectivity.
- E. Costume / Props Labs

1. AV System
 - a. Provide a Monitor
 - b. Provide a Digital Media Player mounted behind the display to display the Camera feeds from the Blackbox

- F. Make-UP Rooms
 1. AV System
 - a. Provide a Monitor
 - b. Provide a Digital Media Player/Decoder mounted behind the display to display the Camera feeds from the Blackbox

- G. Tech Director Office
 1. AV System
 - a. Provide a Monitor
 - b. Provide a Digital Media Player mounted behind the display to display the Camera feeds from the Blackbox
 - c. Provide a button panel controller
 - d. Provide an HDMI Input
 - e. Provide a Wireless Presentation System
 - f. Provide a USB Extender
 - g. Provide a Video Bar with a Camera, Speakers, and Microphone mounted below the display

- H. Corridor
 1. AV System
 - a. Provide a Monitor
 - b. Provide a Digital Media Player mounted behind the display Signage / Announcements

1.8 SUBMITTALS

- A. Provide submittals in accordance with Conditions of the Contract and Division 1, Submittal Procedures section unless otherwise indicated.

- B. Submittals shall contain sufficient information to describe the Work to be performed. Reviewed shop drawings are to be used for final coordination and construction.

- C. Shop drawings must be original work produced by the Contractor responsible for performing the work defined in this specification. Scanning, photographic copying, materially copying, or any other reproducing the contents of the drawings or specifications contained within the Contract Documents will be marked as unacceptable and not reviewed for any content. No claim shall be made for delay, undue burden, or additional costs for the effort to produce shop drawings, schedules, and equipment lists addressing this specification or the overall project manual.

- D. Supplementary submittal requirements:
 1. Provide the following in one electronic submission for review within thirty days of issuance of Notice to Proceed (NTP) and prior to commencement of Work:
 - a. Complete schedule of submittals.
 - b. Chronological schedule of Work in bar chart form.
 - c. Product Data Sheets:
 - 1) Provide a complete table of contents with the following information:
 - 2) Project title.
 - 3) Submittal number. In the case of a resubmittal, use the original submittal number immediately followed by the suffix "R" immediately followed by a unique number and be numbered in consecutive order.
 - 4) Date of submission.

- 5) Provide a list of and Manufacturer's data sheets on products to be incorporated with the Work. Arrange data sheets in the same order they appear in this specification. Where a data sheet shows more than one product, indicate the model being proposed with an arrow or other appropriate symbol.
 - 6) Submit manufacturer's product literature for each type of firestop material to be used. Literature shall include documentation of UL classifications or approved third party testing. Manufacturer's name and number for each part shall be included. Submit drawings of through penetrations, which include the system to be utilized for the firestopping application. Drawing shall indicate construction of wall or floor assembly; size, number and material of penetrating items; firestop system designation; required F-rating, T-rating and remarks.
 - 7) Upon Owners and/or Consultant's request provide (3) three copies of the submittals. Bind submittal in titled three ring D style binders sized for 150 per cent of the material. Maximum size: three-inch spine. Use multiple volumes as required. Separate major grouping with labeled binder tabs.
 - 8) Submissions that do not follow the format and configuration described above will be returned without review.
- d. Shop Drawings:
- 1) Functional Diagrams/Schematics:
 - a) Detailed wiring diagrams showing interconnection of components and products, wiring and cabling diagrams depicting cable types and designators, and device designators for each system. Provide connector designations and terminal strip identification, along with color codes for cables connecting to these devices. Give each component a unique designator and use this designator consistently throughout the project.
 - 2) Coordination Drawings:
 - a) Prepare and submit a set of coordination drawings showing major elements, components, and devices of the audio and video system in relationship with other building components. Prepare drawings to an accurate scale of 1/8"=1'-0" or larger on suitable sized media.
 - b) Prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all equipment. Indicate locations where space is limited, and where sequencing and coordination of installations is of importance to the efficient flow of the Work including but not necessarily limited to the following:
 - (1) Equipment housings
 - (2) Ceiling and wall mounted devices
 - (3) Raceways
 - (4) Cabling
- e. Equipment: Location of equipment within racks, consoles, or on tables, with dimensions; wire routing and cabling within housings; AC power outlet and terminal strip locations.
- f. Patch panel(s): Layouts and designation (labeling) strips, including color schemes.
- g. Full fabrication details of any custom enclosures and millwork indicating size, material, finish and openings for equipment.
- h. Structural rigging and mounting details:
 - 1) Loudspeaker rigging, suspension, and mounting detail drawings shall be signed and sealed by a professional engineer licensed to practice in the state in which the project is located. The signed and sealed drawings noted above to include the following:
 - a) Analysis of all components in the load path and attachment method to building structure for suspended loudspeakers.

- b) Attachment method for mounting brackets at ceilings, walls, or other building features.
 - c) Detail the product manufacturer, part numbers, and load capacity of the hardware fittings and materials selected for suspended or mounted loudspeakers.
 - d) A copy of the design calculations.
 - e) Secondary steel required for attachment to the building structure.
 - f) Custom brackets, mounts, suspension grids or trusses, loudspeaker cabinet frames, or loudspeaker brackets.
 - g) Loudspeaker brackets or mounts provided by the specific loudspeaker manufacturer being installed that do not include traceability data.
 - 2) Traceability data and/or ANSI standard compliance data for loudspeaker mounting brackets or rigging provided by the loudspeaker manufacturer.
 - 3) Risk analysis data as referenced in Part 3.2, F
 - 4) Stamping Engineer post-installation sign-off as described in Part 3.2, F
 - 5) Proof of ETCF certification for on-site rigging crew.
 - i. Projector, loudspeaker, camera mounting details, include hardware types and load capacity.
 - j. Fabricated Plates and Panels
 - 1) Provide complete drawings on custom fabricated plates or panels. Drawings shall include dimensioned locations of components, component types, engraving information, plate material and color, and bill of material.
 - k. Labeling
 - 1) Equipment and cabling labeling scheme. Include font sizes and styles, explanation of scheme, and designator schedule.
 - l. Schedules
 - 1) Wiring schedule showing source and destination of wiring and indicating which wiring is in conduit. Junction box schedule showing type of box, size, mounting and location. Include this information with remainder of wiring diagrams.
 - m. Control System Software
 - 1) Provide electronic copies of proposed control system user interfaces within sixty (60) days of issuance of Notice to Proceed (NTP).
 - n. IP Addresses
 - 1) Coordinated with the venue IT Administrator, provide a list of IP addresses, by device, used in the project.
 - o. Consultant's project documents in electronic format will not be supplied to the Contractor for their use as part of submittals.
 - p. Detail drawings executed at an appropriate scale, but not smaller than 1/8 inch = 1'-0".
 - q. Submissions that do not follow the format and configuration described above will be returned without review.
 - r. Any other pertinent data which is necessary to provide the Work.
 - 2. Control System Software:
 - a. Provide electronic copies of proposed control system user interfaces within sixty (60) days of issuance of Notice to Proceed (NTP).
- E. Resubmission requirements:
- 1. Make all requested corrections or change in submittals required. Resubmit for review until no exceptions are taken.
 - 2. Indicate all changes that have been made other than those requested.

1.9 CONTRACT CLOSE-OUT DOCUMENTS:

- A. Provide submittals in accordance with Conditions of the Contract and Division 1, Submittal Procedures section unless otherwise indicated, after substantial completion but prior to final observation:
- B. Supplementary submittal requirements:
1. Provide the following in one electronic submission for review.
 - a. Equipment Manuals:
 - 1) Manufacturer's owner/instruction manual for each type of Product by manufacturer and model or part number unless specified otherwise herein
 - 2) Supply manufacturer's serial numbers for each Product
 - 3) For custom circuits or modifications, a description of the purpose, capabilities, and operation of each item
 - 4) Separately bind list by manufacturer and model or part number of Products incorporated within the Work, arranged in alpha-numeric order. When applicable, bind the Manufacturer's warranty statements separately.
 - b. Test Reports: Recorded findings of Commissioning.
 - c. Signed copy of turnover equipment to Owner, including quantity, make, and model.
 - d. Copy of any program or hardware setup files.
 - e. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
 - 1) This procedure should describe the operation of system capabilities.
 - 2) Assume the intended reader of the manual is technically inexperienced but unfamiliar with the components and the facility.
 - f. Provide Consultant with a copy of Owner training video.
 - g. Service Information, including service phone number(s) and hours; service schedule; description of products recommended or provided for maintenance purposes; and instructions for the proper use of these products.
 - h. Any other pertinent data generated during the Project or required for future service.
 - i. Within three (3) weeks of final observation, submit the following in one electronic submission for review. Upon Owners and/or Consultant's request, provide (3) three copies of the following:
 - 1) Record drawings: Final rendition of Shop Drawings depicting what is actually incorporated within the Work.
 - 2) Hardcopy full-size set of Record drawings.
 - 3) Three (3) compact disc or DVD's containing Record drawings in AutoCAD editable DWG format and Adobe PDF format. Resolution to be sufficient to permit Owner's technicians to be able to clearly read all notes and text on screen.
 - 4) One set of signed proof-of-training documents.
 2. Submittal Format:
 - a. Record Drawings: Drawings executed at an appropriate scale, but not smaller than 1/8 inch = 1'-0".
 - b. Segregate documents into separate binders containing data relevant to operational, maintenance, and warranty issues. Appropriately duplicate data within the separate bindings when it will reasonably clarify procedures, e.g., operational data in maintenance binding.
 - c. Bind Project Record Manual in titled three ring D style binders sized for 150 percent of the material. Maximum size: three-inch spine. Use multiple volumes as required. Separate major grouping with labeled binder tabs.
- C. Resubmission requirements:
1. Make all requested corrections or changes in submittals required. Resubmit for review until no exceptions are taken.
 2. Indicate all changes that have been made other than those requested.

1.10 CUSTOM SOFTWARE

A. Introduction:

1. Proprietary software provided for the Technical Systems shall be subject to this software license between the Contractor and the Owner as an essential element of the system as defined in the system specification and associated documents, drawings and agreement.
2. Contractor shall agree that 3rd party proprietary software provided with the system shall be subject to this agreement.
3. Contractor and Owner agree that this software license is deemed to be part of, and subject to, the terms of the Agreement applicable to both parties and shall supersede any standard manufacturer or Contractor's standard license agreement.
4. Proprietary software shall be defined to include, but not be limited to, device and system specific software and firmware designed to run on conventional computer based operating platforms as well as all micro-processor based hardware used to program, setup, or operate the system or its components.
5. For sake of this agreement, MS Windows® shall not be considered "proprietary" software, unless a non-public version of Windows® or any of its components are critical to the operation of the system in which case it shall be deemed proprietary.

B. License Grant and Ownership:

1. Contractor hereby grants to Owner a perpetual, non-exclusive, site license to all software for Customer's use in connection with the establishment, use, maintenance, and modification of the system implemented by Contractor. Software shall mean executable object code of software programs and the patches, scripts, modifications, enhancements, designs, concepts, or other materials that constitute the software programs necessary for the proper function and operation of the system as delivered by the Contractor and accepted by the Owner.
2. Except as expressly set forth in this agreement, the Contractor shall at all times own all intellectual property rights in the software. Any and all licenses, product warranties, or service contracts provided by third parties in connection with any software, hardware, or other software or services provided in the system shall be delivered to the Owner for the sole benefit of the Owner.
3. Owner may supply to Contractor or allow the Contractor to use certain proprietary information, including service marks, logos, graphics, software, documents and business information and plans that have been authored or pre-owned by Contractor. All such intellectual property shall remain the exclusive property of Owner and shall not be used by Contractor for any purposes other than those associated with delivery of the system.

C. Copies, Modifications, and Use:

1. Source code shall be available to Owner for a period of not less than 10 years.
2. Owner may make copies of the software for archival purposes and as required for modifications to the system. All copies and distribution of the software shall remain within the direct control of Owner and its representatives.
3. Owner may make modifications to the source code version of the software, if and only if the results of all such modifications are applied solely to the system. In no way does this Software License confer any right for Owner to license, sublicense, sell, or otherwise authorize the use of the software, whether in executable form, source code or otherwise, by any third parties.
4. All express or implied warranties relating to the software shall be deemed null and void in case of any modification to the software made by any party other than Contractor.

D. Warranties and Representations:

1. Contractor represents and warrants to Owner that:
 - a. It has all necessary rights and authority to execute and deliver this Software License and perform its obligations hereunder and to grant the rights granted under this Software License to Owner;

- b. The goods and services provided by contractor under this Software License, including the software and all intellectual property provided hereunder, are original to Contractor or its subcontractors or partners; and
 - c. The software, as delivered as part of the system, will not infringe or otherwise violate the rights of any third party, or violate any applicable law, rule or regulation.
 2. Contractor further represents and warrants that, throughout the System Warranty Period, the executable object code of software and the system will perform substantially in accordance with the System Specifications and Agreement. If the software fails to perform as specified and accepted all remedies are pursuant to the policies set forth in the Specification and in the Agreement. No warranty of any type or nature is provided for the source code version of the software which is delivered as is.
 3. Except as expressly stated in this Agreement, there are no warranties, express or implied, including, but not limited to, the implied warranties of fitness for a particular purpose, of merchantability, or warranty of no infringement of third party intellectual property rights.

1.11 QUALITY ASSURANCE

- A. Qualifications: Contractor to be experienced in the provision of systems similar in complexity to those required for this project, and meet the requirements listed below. Provide documentation at the time of bid to support these qualifications:
 1. Form of corporation.
 2. No less than three years' experience with equipment and systems of the specified types.
 3. Experience with at least three comparable scale projects within the last three years.
 4. Be a franchised dealer and service facility for the manufacturer's products furnished.
 5. Maintain a fully staffed and equipped service facility with full-time field technicians.
 6. Have at least one supervisory on-site employee who has completed and has been certified CTS-I by Infocomm.
 7. Supervision of all rigging by an ETCP certified rigger for all work associated with suspension or mounting of overhead equipment.
 8. Adequate plant capacity and equipment to complete the Work.
 9. Adequate staff with commensurate technical experience.
 10. Suitable financial status (i.e., bonding and materials purchase capacity) to meet the obligations of the Work.
 11. Adequate regional service organization to meet warranty response requirements of the Project.
 12. Provide listing with appropriate explanation regarding the status of Contractor's resolved or unresolved legal disputes within the last six calendar years.
 13. Provide listing with appropriate explanation regarding any projects within the last 3 years where the Contractor has failed to meet construction schedules due to Contractor's cause.
 14. Completed current version of the AIA Contractor's Qualification Form.
- B. Subcontractors: at the time of bid, the Contractor shall provide a list of structural, electrical, sound, or any other subcontractors intended to do the Work, or are being retained as local service providers throughout the warranty period. Subcontractors shall be appropriately state licensed in their specialty and must provide the same qualification documents as the Contractor.
- C. Work: Perform Work in compliance with the applicable standards listed herein and governing codes and regulations of the authorities having jurisdiction and the Contract Documents.
 1. Drawings and specification requirements govern where they exceed Code and Regulation requirements.
 2. Where requirements between governing Codes and Regulations vary, the more restrictive provision applies.
 3. Nothing in the Contract Documents grants authority or permission to disregard or violate any legal requirements.

- D. Coordinate exact location and installation of equipment, power, grounding, and raceway requirements with the Architect.

1.12 DELIVERY, STORAGE & HANDLING

- A. Ship Products in its original container, to prevent damaging or entrance of foreign matter.
- B. Handling and shipping in accordance with Manufacturer's recommendation.
- C. Provide protective covering during construction of all installed devices, to prevent damaging or entrance of foreign matter.
- D. Replace at no expense to Owner, Products damaged during storage, handling or the course of construction.

1.13 PROJECT CONDITIONS

- A. Verify conditions on the job site applicable to this work. Notify Architect in writing of discrepancies, conflicts, or omissions promptly upon discovery.
- B. The Drawings diagrammatically show cabling and arrangements of equipment fitting the space available without interference. If conditions exist which make it impossible to install work as shown, recommend solutions and/or submit drawings to Architect for approval, showing how the work may be installed.

1.14 WARRANTY

- A. Warrant labor and equipment for one year following the date of substantial completion to be free of defects and deficiencies, and to conform to the drawings and specifications as to kind, quality, function, and characteristics. Repair or replace defects occurring in labor or equipment within the Warranty period without charge.
- B. This warranty is in addition to any specific warranties issued by manufacturers for greater periods of time.
- C. Within the warranty period, answer service calls within twenty four (24) hours during normal working hours and correct the deficiency within forty eight (48) hours.
- D. Provide Owner with the name and telephone number of the person to call for service. This information to be part of Project Closeout Documents.
- E. Thirty days prior to the end of the warranty period provide a complete checkout of all system components. Repair or replace any defective equipment discovered during the testing. Correct any defects in wiring or other functional problems reported by Owner. Warranty replacement and service of equipment shall not apply to Owner furnished equipment (OFE). Coordinate observation visit with the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Products quantity is as required. If a quantity is given, provide at least the given amount. Some product listed may not be required to fulfill the obligations of the Work.
- B. Equipment and materials shall be new and conform to applicable UL or ANSI provisions.

- C. Regardless of the length or completeness of the descriptive paragraph herein, provide Products complying with the specified manufacturer's published specifications.
- D. Remove or blank out all manufacturers' names, logos, or other symbols from loudspeakers or other objects placed in view of the public. If logos are removable, remove and repaint to the color of the adjacent surface and reattach.
- E. Take care during installation to prevent scratches, dents, chips, etc.

2.2 ACCEPTABLE MANUFACTURERS

- A. Model numbers and manufacturers included in this specification are listed as a standard of function, performance, and quality.
- B. Refer to General and Supplementary Conditions and Division 1 Specification Sections for equipment substitution procedure.
- C. If a specified product has been discontinued by a manufacturer, provide the replacement model (as certified by the manufacturer) at no additional cost.
- D. Where required provide manufacturer's rack mount adapter or one manufactured by Middle Atlantic or Winstead unless specified elsewhere.

2.3 MICROPHONES AND ACCESSORIES

- A. Single Wireless Microphone System (WRLS, Type 1):
 - 1. Not specified
- B. Dual Wireless Microphone System (WRLS, Type 2):
 - 1. Receiver Type: Digital Wireless System with automatic switching diversity reception with XLR type audio output connectors.
 - 2. Indicators: LED signal strength meters for battery, RF and audio levels.
 - 3. Frequency: Coordinate with FCC and local requirements.
 - 4. Antennas: Rear mount passive antennas for the frequency spectrum chosen.
 - 5. 1-RU Rack mountable.
 - 6. Acceptable Product:
 - a. Shure ULXD4D Diversity Receiver
 - 7.
- C. Triple Wireless Microphone System (WRLS, Type 3)
 - 1. Not specified
- D. Quad Wireless Microphone System (WRLS, Type 4):
 - 1. Receiver Type: Digital Wireless System with automatic switching diversity reception with XLR type audio output connectors.
 - 2. Indicators: LED signal strength meters for battery, RF and audio levels.
 - 3. Frequency: Coordinate with FCC and local requirements.
 - 4. Antennas: Rear mount passive antennas for the frequency spectrum chosen.
 - 5. 1-RU Rack mountable.
 - 6. Acceptable Product:
 - a. Shure ULXD4Q Diversity Receiver
- E. Bodypack Wireless Microphone (Type 1)
 - 1. Theatrical headset/lapel mic
 - 2. Acceptable Product:

- a. Shure ULXD1 Bodypack Transmitter
 - 1) Shure SB900B Lithium Ion Battery
 - 2) Shure UL4#-MTQG Microphone (coordinate color with Owner)
 - 3) Shure MX153B/O-TQG
 - 4) Shure MX153C/O-TQG
 - 5) Shure MX153T/O-TQG

- F. Handheld Wireless Microphone (Type 1)
 - 1. Beta 87A capsule
 - 2. Acceptable Product:
 - a. Shure ULXD2/B87A Handheld Transmitter
 - 1) Shure SB900B Lithium Ion Battery

- G. Wireless Microphone Charge Base (Type 1)
 - 1. 8 Port Wireless Microphone Charging Dock
 - 2. Acceptable Product
 - a. Shure SBC800-US Battery Charger Base

- H. General Purpose Microphone: (Type 1)
 - 1. Handheld dynamic cardioid pattern
 - 2. Acceptable Product:
 - a. Shure SM58
 - b. Approved Equivalent

- I. Suspended Microphone: (Type 1)
 - 1. Phantom powered
 - 2. Acceptable Product:
 - a. Audix ADX40 with CPSADXC cardioid capsule
 - b. Shure MX202B/C
 - c. Approved Equivalent

- J. Microphone Stands and Mounting Hardware:
 - 1. Acceptable Product:
 - a. TYPE 1: Round-base floor stands, Black
 - 1) Atlas MS-10CE w / PB11XEB
 - 2) Approved Equivalent
 - b. TYPE 2: Heavy Duty floor stand, Black
 - 1) Atlas SB11WE
 - 2) Approved Equivalent
 - c. TYPE 3: Boom Arm Short, Black
 - 1) Atlas PB11XEB
 - 2) Approved Equivalent
 - d. TYPE 4: Boom Arm Long, Black
 - 1) AtlasPB21XEB
 - 2) Approved Equivalent
 - e. TYPE 5: Tabletop stand, Black
 - 1) Atlas SMS2B
 - 2) Approved Equivalent

2.4 INPUT SOURCES

- A. Media Player (MDP, Type 1):
 - 1. Analog outputs: RCA unbalanced, Balanced XLR
 - 2. Media Format: USB, CD
 - 3. File Formats: CD, MP3, WAV
 - 4. Stereo playback

5. 1-U Rack Mountable
 6. Wired Remote Control
 7. Acceptable Product:
 - a. Denon DN-500CB
 - 1) Denon RS-232C
- B. Media Recorder (MDR, Type 1):
1. Analog inputs and outputs: RCA unbalanced, Balanced XLR
 2. Digital input and output: S/PDIF, AES/EBU
 3. Media Format: SD, USB, CD
 4. File Formats: CD, MP3, WAV
 5. Stereo Record and Playback
 6. Ethernet connectivity
 7. 1-U Rack Mountable.
 8. Wired Remote Control.
 9. Acceptable Product:
 - a. Tascam SS-CDR250N
- C. Stereo DI Box (Type 1):
1. Inputs for stereo/dual mono unbalanced line sources
 2. Inputs shall be via ¼", RCA, 3.5mm receptacles
 3. Line and mic level outputs
 4. Ground lift switch
 5. Acceptable Product:
 - a. Whirlwind DIRECT2
 - b. Radial ProAV2
 - c. Approved Equivalent

2.5 MIXERS

- A. Mixer (MIXER, Type 1):
1. 16 input digital rackmount mixer
 2. 8 outputs
 3. 48 channels
 4. 36 mix busses
 5. USB audio input/output.
 6. Rack Mountable.
 7. Acceptable Product:
 - a. Allen & Heath SQ-5
 - 1) Allen & Heath SQ-Dante 32x32 Card
 - 2) SKB 1SKB-RE-SQ5
- B. Input/Output Expander (MIX IO, Type 1)
1. Digital audio expander.
 2. 16 balanced inputs
 3. 8 balanced outputs
 4. Dante network audio
 5. Acceptable Product:
 - a. Allen & Heath DT168
- C. Mixer Controller (Type 1)
1. Touchscreen wireless controller
 2. 9.7 inch display
 3. Acceptable Product to Include:
 - a. Apple iPad Air 2 (or current version)
 - 1) Otterbox Latch II

- 2) Otterbox Defender Series
- 3) Allen & Heath SQ MixPad App

2.6 DIGITAL SIGNAL PROCESSORS

- A. Digital Signal Processing System (DSP)
1. Provide independent DSP processing for each system as detailed on the AV drawings.
 2. The DSP system and control software shall be operational 30 days prior to the first use of the installed system.
 3. Function: Provide all signal processing and control required for the system(s). Devices required include, but are not limited to; mixer, matrix router, crossover, high and low pass filters, delay, compression, 6-band parametric equalizer, limiter, ducker, signal delay, and external control.
 4. Unit to be configured with a minimum quantity of inputs and outputs as shown within the AV drawings, including control port requirements.
 5. Signal flow and routing to be fully user configurable.
 6. Unit to permit hardwire connection of external switches for recalling presets.
 7. Unit to permit remote networked control via dedicated devices.
 8. Access to external user-adjustable controls shall be restricted.
 9. Manufacturer Software:
 - a. Provide 12 months of on-site software upgrades from date of final acceptance.
 10. DSP Software Setup:
 - a. Provide site specific configuration and programming for the DSP software.
 - b. Coordinate user interface, software functionality, and menu screens with Architect's Consultant. Reference submittal requirements.
 - c. Provide ongoing software upgrades and maintenance for 12 months from date of final acceptance.
 - d. Reference Part 3.4 System Programing in this specification for additional programming details.
 11. Where DSP and Amplifiers are used in the same system, use processing and amplification products of the same platform.
- B. Digital Signal Processor (DSP, Type 1)
1. Acceptable Product:
 - a. QSC Q-Sys Core 110f
 - 1) QSC QIO-GP8x8
 - b. BSS BLU-100

2.7 POWER AMPLIFIERS

- A. General:
1. Two, Four, or Eight channel power amplifier with the EIA standard RS-490 power rating at 1% THD into 70-volt constant voltage load or 8-ohm load as applicable.
 2. Provide protection of circuit components in the event of input over-drive, output overload, or short circuits.
 3. Frequency response: ± 1 dB, 20 Hz to 20 kHz with less than 1 per cent THD at rated output.
 4. Input impedance: 10k ohm balanced.
 5. Output regulation: 2 dB from no load to full load conditions.
 6. Noise generation: at least 85 dB below rated output with input shorted.
- B. Acceptable products:
1. Type 1:
 - a. QSC CX-Q 2K4
 - b. Crown CDi 300BL Series
 - c. LEA CONNECT 35xD

2. Type 2:
 - a. QSC CX-Q 4K series
 - b. Crown CDi 600BL Series
 - c. LEA CONNECT 70xD
3. Type 3:
 - a. QSC CX-Q 8K series
 - b. Crown CDi 1200BL Series
 - c. LEA CONNECT 1504D

2.8 LOUDSPEAKERS

- A. General
 1. Coordinate loudspeaker/grille and hardware colors with Owner
 2. Provide all necessary mounting hardware, brackets, supports and any secondary steel required to attach loudspeaker to building structure.
- B. Speaker (Type 1)
 1. Type: pendant loudspeaker
 2. Configuration: 6.5-inch driver and a 1-inch dome tweeter
 3. Frequency Response: 75 Hz – 17 kHz
 4. Power: 150W @ 8 ohms
 5. Taps: 60W / 30W / 15W / 7.5W @ 70V
 6. Coverage: 75-degree conical
 7. Acceptable Product:
 - a. JBL Control 67HC/T
- C. Speaker (Type 2)
 1. Type: flush mount speaker
 2. Configuration: 8 inch driver and a 1-inch tweeter
 3. Frequency Response: 30 Hz – 20 kHz
 4. Power: 100W @ 8 ohms
 5. Taps: 50W / 25W / 12W / 6W @ 70V
 6. Coverage: 180 x 160
 7. Acceptable Product:
 - a. JBL Control 128 WT
- D. Speaker (Type 3)
 1. Type: ceiling loudspeaker
 2. Configuration: 4 inch coaxial driver and a 3/4-inch soft dome tweeter
 3. Frequency Response: 80 Hz – 20 kHz
 4. Power: 80W @ 16 ohms
 5. Taps: 60W / 30W / 15W / 7.5W @ 70V
 6. Coverage: 130-degree conical
 7. Acceptable Product:
 - a. JBL Control 24CT
 - b. QSC AC-C4T
 - c. Community D4
- E. Speaker (Type 4)
 1. Type: ceiling loudspeaker
 2. Configuration: 6.5-inch driver and a 1-inch dome tweeter
 3. Frequency Response: 55 Hz – 20 kHz
 4. Power: 150W @ 8 ohms
 5. Taps: 60W / 30W / 15W / 7.5W @ 70V
 6. Coverage: 120-degree conical
 7. Acceptable Product:

- a. JBL Control 47CT
- b. QSC AC-C6T
- c. Community D6

- F. Speaker (Type 5)
1. Type: Surface mounted loudspeaker
 2. Configuration: 8-inch two-way loudspeaker
 3. Frequency Range: 62 Hz – 16 kHz
 4. Taps: 60W / 30W / 15W / 7.5W @ 70V
 5. Coverage: 100 X 100 degree
 6. Acceptable Product:
 - a. JBL Control 28-1
 - 1) JBL MTC-28UB-1

- G. Speaker (Type 6)
1. Type: Surface mounted loudspeaker
 2. Configuration: 12-inch two-way loudspeaker
 3. Frequency Range: 55 Hz – 20 kHz
 4. Power: 600W @ 8 ohms
 5. Coverage: 90-degree conical
 6. Acceptable Product:
 - a. Tannoy VX12
 - 1) Tannoy VXY12 Yoke Mount
 - 2) Mega Clamp MLB
 - 3) Black Safety Cable

2.9 LOUDSPEAKER HARDWARE AND SUPPORT STRUCTURE

- A. All rigging truss modules, slings and hardware to meet a minimum of one of the following standards.
1. ASME B30.26
 2. ASME B30.9
 3. OSHA 1910.184
 4. OSHA 1926.251
 5. UL 1480 31.3
- B. Shoulder Type Machinery Eye Bolts:
1. Forged Steel - Quenched and Tempered.
 2. Fatigue rated at 1-1/2 times the Working Load Limit at 20,000 cycles.
 3. Product to meet or exceed all the requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements.
 4. Select size of product based working load limits required.
 5. Acceptable Product:
 - a. Crosby Group S-279 / M-279 Series
- C. Forged Eye Nuts:
1. Forged Steel - Quenched and Tempered.
 2. Tapped with standard UNC class 2 threads after galvanizing.
 3. Product to meet or exceed all the requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements.
 4. Select size of product based working load limits required.
 5. Acceptable Product:
 - a. Crosby Group G-400 Series
- D. Anchor Shackles:
1. Forged - Quenched and Tempered, with alloy pin.

2. Working Load Limit permanently shown on every shackle.
3. Hot Dip galvanized or Self-Colored.
4. Product to meet the performance requirements of Federal Specification RR-C-271D Type IVA, Grade A, Class1.
5. Select size of product based working load limits required.
6. Provide all screw pin type shackles with mouse wire.
7. Acceptable Product:
 - a. Crosby Group G-213 / S-213 Series Round Pin
 - b. Crosby Group G-209 / S-209 Series Screw Pin

E. Turnbuckles:

1. Acceptable turnbuckle assembly combinations include: Eye and Eye, Jaw and Jaw, Jaw and Eye.
2. End fittings are Quenched and Tempered, bodies heat treated by normalizing.
3. Hot Dip galvanized.
4. Product to meet or exceed all the requirements of ASME B30.26 including identification, ductility, design factor, proof load and temperature requirements.
5. Product to meet the performance requirements of Federal Specifications FF-T-791b, Type 1 Form 1 - CLASS 4, and ASTM F-1145.
6. Select size of product based working load limits required.
7. All end fittings to be moused to the body with mousing cable.
8. Acceptable Product:
 - a. Crosby Group HG-226 Series, Eye and Eye
 - b. Crosby Group HG-227 Series, Jaw and Eye
 - c. Crosby Group HG-228 Series, Jaw and Jaw

F. Wire Rope:

1. Strands: 7 x 19 Utility Cable.
2. Type: Galvanized.
3. Select size of product based working load limits required.
4. Acceptable Manufacturer:
 - a. Wire Rope Corporation of America (WRCA)

G. Wire Rope Thimble:

1. Product to meet the performance requirements of Federal Specification FF-T-276b Type II.
2. Hot Dip galvanized.
3. Select size of product based wire rope size required for suspended load.
4. Acceptable Product:
 - a. Crosby Group G-411 Series

H. Wire Rope Sleeves:

1. Type: Copper Duplex.
2. Select size of product based wire rope size required for suspended load.
3. Acceptable Product:
 - a. Wire Rope Corporation of America (WRCA) SW-740 Series

2.10 ASSISTIVE LISTENING

A. ALS Transmitter (ALT, Type 1):

1. Configuration: Single-channel.
2. Frequency: 216 MHz.
3. Audio Input: Balanced, mic or line level, 3-pin XLR.
4. Provide power supply.
5. Provide 1-RU rack mount bracket.
6. Remote mounted antenna (ANT-HA)

7. Acceptable Product:
 - a. Listen Technologies LS-71-216
 - 1) Listen Technologies LA-124 for device/panel mounted antennas
 - b. William Sound FM-558 Pro
 - 1) William Sound ANT 034 for device/panel mounted antennas

- B. ALS Receiver (Type 1):
 1. Configuration: Single channel.
 2. Frequency: 216 MHz.
 3. Frequency agile to adjust various systems.
 4. Receivers to be frequency adjustable for use in all venues.
 5. Include an individual price for owner to purchase additional receivers.
 6. Acceptable Product:
 - a. Listen LR-4200-216 Receiver
 - 1) Listen LA-401 Ear Speaker
 - 2) Listen LA-402 Headset
 - 3) Listen LA-430 Neck Loop
 - b. William Sound FM-R38
 - 1) William Sound EAR 022
 - 2) William Sound HED 024
 - 3) William Sound NKL 001

2.11 PRODUCTION INTERCOM

- A. Master Station (ICMS, Type 1):
 1. Four channel main station.
 2. Separate short circuit protection for each channel
 3. External program feed to either or both channels.
 4. Call signal buttons for each channel.
 5. Global "Remote Mic Kill"
 6. 2RU height unit
 7. Acceptable Product:
 - a. Clear Com MS-704
 - 1) Clear Com CC-300

- B. Intercom Combiner (ICC, Type 1)
 1. Channel A+B combine
 2. 3 pin single channel input
 3. 3 pin two channel output
 4. Acceptable Product:
 - a. Clear Com TWC-703

- C. Wall Stations (ICS, Type 1):
 1. One channel speaker station
 2. Flush mount internal microphone.
 3. Visual and audible call signaling.
 4. Mounts in four gang junction box
 5. Acceptable Product:
 - a. Clear Com KB-701

- D. Wall Stations (ICS, Type 2):
 1. Two channel speaker station
 2. Visual and audible call signaling.
 3. Mounts in four gang junction box
 4. Acceptable Product:
 - a. Clear Com KB-702

1) Clear Com CC-300

- E. Belt Unit (Type 1)
 - 1. Two channel station
 - 2. Volume control
 - 3. Mic on/off button
 - 4. Call signal button.
 - 5. Sidetone adjust.
 - 6. Three pin configuration with loop thru.
 - 7. Acceptable Product:
 - a. Clear Com RS-703
 - 1) Clear Com CC-300

- F. Headset (Type 1)
 - 1. Single earpiece unit.
 - 2. Noise cancelling microphone.
 - 3. Flexible boom arm with 300-degree rotation.
 - 4. Acceptable Products:
 - a. Clear Com CC-300

- G. Headset (Type 2)
 - 1. Dual earpiece unit.
 - 2. Noise cancelling microphone.
 - 3. Flexible boom arm with 300-degree rotation.
 - 4. Acceptable Products:
 - a. Clear Com CC-400

- H. Handset (Type 1)
 - 1. Telephone style hand set
 - 2. Push to talk button
 - 3. Acceptable Product:
 - a. Clear Com HS-6

- I. Call Signal Flasher (Type 1)
 - 1. LED light source
 - 2. Visual and Audible alert
 - 3. Volume/Brightness control
 - 4. Acceptable Product:
 - a. Clear Com FL-7

2.12 PROJECTION SCREENS

- A. Large Electric Projection Screen (PS, Type 1)
 - 1. General: Provide manufacturer's standard units consisting of screen and other components as required for a complete installation.
 - 2. Provide rigging and mounting hardware as required.
 - 3. Comply with the following requirements for the viewing surface:
 - a. Tab tensioned screen
 - b. 1.1 HD Progressive surface material
 - c. 16:9 aspect ratio
 - 4. Provide custom black drop as required to locate bottom of image as specified in AV Drawings. This extra black drop amount needs to be calculated in the field based on the actual finished installation height.
 - 5. Screen size: reference Projection Screen Schedule in AV drawings
 - 6. Acceptable Product:
 - a. Da-Lite Tensioned Professional Electrol – Custom

2.13 VIDEO PROJECTORS

- A. Video Projector (PROJ, Type 1):
 - 1. 3 LCD laser light source
 - 2. Brightness 10,000 ANSI lumens
 - 3. Native resolution 1920x1200X2
 - 4. Control Communication RS-232C
 - 5. Field verify throw distance to determine the appropriate required lens
 - 6. Provide required lens
 - 7. Acceptable Product:
 - a. Epson EB-PU2010B

2.14 VIDEO DISPLAYS

- A. Flat Panel Monitor (MON, Type 1):
 - 1. 50" LCD screen size
 - 2. Brightness 500nits
 - 3. Panel resolution 3,840 x 2,160 (16:9)
 - 4. Input: (3) HDMI (1) DP,
 - 5. Output: Stereo Mini Jack, 10w 2ch Speaker
 - 6. External Control: RS232, RJ45
 - 7. Acceptable Product:
 - a. Samsung QM50C w/ Chief RL
- B. Flat Panel Monitor (MON, Type 1):
 - 1. 55" LCD screen size
 - 2. Brightness 500nits
 - 3. Panel resolution 3,840 x 2,160 (16:9)
 - 4. Input: (3) HDMI (1) DP,
 - 5. Output: Stereo Mini Jack, 10w 2ch Speaker
 - 6. External Control: RS232, RJ45
 - 7. Acceptable Product:
 - a. Samsung QM55C w/ Chief RLF3
- C. Flat Panel Monitor (MON, Type 2):
 - 1. 65" LCD screen size
 - 2. Brightness 500nits
 - 3. Panel resolution 3,840 x 2,160 (16:9)
 - 4. Input: (3) HDMI (1) DP,
 - 5. Output: Stereo Mini Jack, 10w 2ch Speaker
 - 6. External Control: RS232, RJ45
 - 7. Acceptable Product:
 - a. Samsung QM65C w/ Chief RLF3
- D. Flat Panel Monitor (MON, Type 1):
 - 1. 75" LCD screen size
 - 2. Brightness 500nits
 - 3. Panel resolution 3,840 x 2,160 (16:9)
 - 4. Input: (3) HDMI (1) DP,
 - 5. Output: Stereo Mini Jack, 10w 2ch Speaker
 - 6. External Control: RS232, RJ45
 - 7. Acceptable Product:

- a. Samsung QM75C w/ Chief RLF3

E. Flat Panel Monitor (MON, Type 3):

1. 85" LCD screen size
2. Brightness 500nits
3. Panel resolution 3,840 x 2,160 (16:9)
4. Input: (3) HDMI (1) DP,
5. Output: Stereo Mini Jack, 10w 2ch Speaker
6. External Control: RS232, RJ45
7. Acceptable Product:
 - a. Samsung QM85C w/ Chief RLF3

2.15 AV SOURCES

A. Wireless Presentation System (WPS, Type 1)

1. Wirelessly Share Content from mobile devices
2. Conferencing Capabilities included for a BYOD conferencing solution
3. Supports MS Windows, OSX as well as Apple and Android smartphones and tablets
4. Simultaneous display from up to 4 devices
5. Moderator controlled
6. HDMI output
7. USB Port
8. Acceptable Product:
 - a. Mersive Solstice Pod Gen 3 Unlimited Enterprise, SP-8000-E5

B. Digital Media Player (DMP, Type 1)

1. Digital signage player
2. 4k video resolution
3. Acceptable product:
 - a. BrightSign XD1035 W/ 32GB MicroSD Class 10 Card

2.16 TRANSMITTERS / RECEIVERS

A. DTP Transmitter (DTP-TX, Type 1):

1. Long Distance DTP Transmitter for HDMI - Decorator-Style Wallplate
2. Converts HDMI to CAT5e/6.
3. Transmits HDMI up to 330 feet
4. Supports computer and video resolutions up to 4K
5. HDCP 2.3 compliant
6. Color: Black (Coordinate with Architect)
7. Acceptable Product:
 - a. Extron DTP T HWP 4K 331 D (60-1421-52)

B. DTP Transmitter (DTP-TX, Type 2):

1. Long Distance DTP Transmitter for HDMI
2. Converts HDMI to CAT5e/6.
3. Transmits HDMI up to 330 feet
4. Supports computer and video resolutions up to 4K
5. HDCP 2.3 compliant
6. Acceptable Product:
 - a. Extron DTP2 T 211 (60-1631-62)

2.17 ENCODERS/DECODERS

A. AV over IP Encoder (ENC, Type 1)

1. 1G Pro AV over IP Encoder with DTP Input
 2. Converts, encodes, and streams video and audio signals from DTP transmitters over 1 Gbps Ethernet networks
 3. Supports HDMI 2.0 at resolutions up to 4K/30 @ 4:4:4
 4. Supports a maximum transmission distance of 330 feet (100 meters) for all compatible resolutions when used with CATx shielded twisted pair cable.
 5. 1U high, half rack width metal enclosure
 6. Acceptable Product:
 - a. Extron NAV E 101 DTP (60-1525-15)
- B. AV over IP Encoder (ENC, Type 2)
1. 1G Pro AV over IP Encoder – HDMI
 2. Encodes and streams video and audio over 1 Gbps Ethernet networks
 3. Supports HDMI 2.0 at resolutions up to 4K/60 @ 4:4:4
 4. HDMI loop-through
 5. 1" (2.5 cm) high, half rack width metal enclosure
 6. Acceptable Product:
 - a. Extron NAV E 101 (60-1525-12)
- C. AV over IP Scaling Decoder (DEC, Type 1)
1. Supports eight displays per workstation
 2. HDMI up to 4K @ 60Hz (4096 x 2160) with full 4:4:4 chroma subsampling
 3. PoE+ compatibility
 4. 1" (2.5 cm) high, half rack width metal enclosure
 5. Acceptable Product:
 - a. Extron NAV SD 101 (60-1525-14)
- D. NAVigator (NAV, Type 1)
1. Acceptable Product:
 - a. Extron NAVigator (60-1534-01) w/ LinkLicense for total number of endpoints

2.18 CONTROL SYSTEM

- A. Room Control System (RCS, Type 1):
1. Quad Core Control Processor
 2. (8) RS232 Ports
 3. (8) IR/Serial Ports
 4. (8) Relays
 5. (4) Digital I/O Ports
 6. AV LAN
 7. LL UI Upgrade
 8. Acceptable Product:
 - a. Extron IPCP Pro 555Q xi (60-1917-01A)

2.19 USER INTERFACES

- A. Touch Panel (TP, Type 1):
1. Screen size: 10-inch diagonal
 2. Capacitive touch surface
 3. Resolution: 1280 x 800
 4. PoE powered.
 5. Wall Mount
 6. Acceptable Product:
 - a. Extron TLP Pro 1025M – Black (60-1566-02)
- B. Touch Panel (TP, Type 2):

1. Screen size: 10-inch diagonal
 2. Capacitive touch surface
 3. Resolution: 1280 x 800
 4. PoE powered.
 5. Tabletop
 6. Acceptable Product:
 - a. Extron TLP Pro 1025T – Black (60-1565-02)
- C. Touch Panel (TP, Type 3):
1. Screen size: 7-inch diagonal
 2. Capacitive touch surface
 3. Resolution: 1024 x 600
 4. PoE powered.
 5. Wall Mount
 6. Acceptable Product:
 - a. Extron TLP Pro 725M – Black (60-1563-02)
- D. Button Panel (BP, Type 1):
1. Fully customizable Network Button Panel uses standard Ethernet connectivity
 2. Eight backlit, soft-touch buttons that can be customized
 3. PoE powered.
 4. Wall Mount
 5. Acceptable Product:
 - a. Extron NBP 108 D (60-1818-01)
- E. Button Panel (BP, Type 2):
1. Controller with RS-232 Control - Decorator-Style Wallplate
 2. Eight backlit, soft-touch buttons that can be customized
 3. Wall Mount
 4. Acceptable Product:
 - a. Extron MLC 62 RS D (60-1005-02)

2.20 PTZ CAMERA

- A. Camera (CAM & CAM-RX, Type 1)
1. Back-illuminated 8.51 Megapixel, ultra-high-definition 1/2.5-type CMOS sensor delivers native 2160p/30 (3840 x 2160) video
 2. 20x optical zoom with 30x lossless zoom at 3840 x 2160. Achieve 40x zoom at full HD resolution
 3. Genlock signal for multi-camera synchronization
 4. Simple, clutter-free camera extension with HDBaseT technology
 5. Power, video and control over a single Cat-6 cable up to 328 ft. (100m)
 6. Acceptable Product:
 - a. Vaddio RoboSHOT 40 UHD OneLINK HDMI System
- B. Camera Controller (PCC, Type 1)
1. Precise PTZ control with three-axis industrial-grade Hall effect joystick
 2. Control up to four cameras with a user-defined home position plus four presets per camera
 3. Low-profile, weighted steel chassis with soft feet for stability on any surface
 4. HDMI output displays a decoded IP stream from the selected camera (must be enabled on the camera)

5. Acceptable Product:
 - a. Vaddio PCC Mini Four Camera Controller

2.21 CONFERENCING

- A. All-in-One Soundbar (SB, Type 1)
 1. Acceptable products:
 - a. Biamp Parle ABC 2500

2.22 USB EXTENDERS

- A. USB Extender Transmitter (USB-TX, Type 1)
 1. Acceptable product
 - a. Extron USB Extender Plus T (60-1471-12)
- B. USB Extender Receiver (USB-RX, Type 1)
 1. Acceptable product
 - a. Extron USB Extender Plus R (60-1471-13)

2.23 AV NETWORK HARDWARE

- A. Network Switch (AVSW, Type 1)
 1. Managed
 2. Gigabit switch
 3. PoE+
 4. Streaming compatible
 5. Acceptable Product:
 - a. Netgear M4250 Series
 - b. Packedge SX Series
 - c. Luxul AMS Series
 - d. QSC NS Gen-2 Series
 - e. Approved Equivalent
- B. AV Access Point (AP, Type 1)
 1. Wi-Fi AC/N/G/B/A standards
 2. Acceptable Product:
 - a. Luxul XAP-810
 - b. Packedge WK-2
 - c. Approved Equivalent

2.24 POWER SYSTEMS

- A. Rack Power Distribution
 1. Rack mountable vertical distribution.
 2. Used for additional outlets where needed.
 3. Size strip to number of required outlets.
 4. Acceptable Product:
 - a. Middle Atlantic PDT Series
 - b. Middle Atlantic PD Slim Series
- B. Power Protection with Lights (POWER/LIGHT):
 1. 20 Amp power system.
 2. Eight switched AC outlets.
 3. Acceptable Product:

- a. Furman Sound PL-PRO C
- b. Approved Equivalent

- C. Power Protection with Lights (POWER/LIGHT):
 - 1. For portable rack applications
 - 2. 15 Amp power system.
 - 3. Eight switched AC outlets.
 - 4. Acceptable Product:
 - a. Furman Sound PL-8C
 - b. Approved Equivalent

- D. Rackmount Uninterruptible Power Supply (UPS)
 - 1. Provide UPS systems to maintain power to all networking and processing equipment, including digital audio mixer systems and recording equipment.
 - 2. UPS's shall be on-line style with sufficient battery reserve to operate for 15 minutes. Size each UPS unit for 25% additional capacity.
 - 3. Rack mountable.
 - 4. Acceptable Product:
 - a. Middle Atlantic Select Series UPS
 - b. APC Easy UPS Series

- E. Power Supplies:
 - 1. As required.

2.25 EQUIPMENT HOUSING AND ACCESSORIES

- A. General
 - 1. Refer to drawings for equipment rack sizes and additional notes.

- B. Freestanding Equipment Rack (Type 1)
 - 1. Finish: Black powder coat.
 - 2. Tapped 10-32 rack rails
 - 3. Provide side, top, and bottom panels.
 - 4. Acceptable Product:
 - a. Middle Atlantic BGR series
 - 1) Middle Atlantic BGR-552FT-FC
 - 2) Middle Atlantic VFD series

- C. Credenza AV Rack (Type 1)
 - 1. Type: Credenza Rack
 - 2. Provide Middle Atlantic Vent kit(s) as needed.
 - 3. Acceptable Product:
 - a. Middle Atlantic SRSR series

- D. Portable Equipment Rack (Type 1)
 - 1. Size: 8RU front with 12RU Top
 - 2. Tapped 10-32 rack rails
 - 3. Acceptable Product:
 - a. SKB 1SKB19-R1208

- E. Rack Blanks (BLANK)
 - 1. Flanged, aluminum panel.
 - 2. Anodized finish.
 - 3. Acceptable product:
 - a. Middle Atlantic BL series

- F. Rack Vents (VENT)
 - 1. Flanged, aluminum panel.
 - 2. Anodized finish.
 - 3. Acceptable product:
 - a. Middle Atlantic VTP series

- G. Cable Management
 - 1. Brush grommet panel
 - 2. Acceptable Product:
 - a. Middle Atlantic BR series

- H. Rack Drawers (DRAWER)
 - 1. Blank anodized finish
 - 2. Acceptable product:
 - a. Middle Atlantic D series

- I. Equipment Rack Screws:
 - 1. Install rack mounted equipment with black 10-32 star post security screws with flat nylon washers.
 - 2. Quantity as required.
 - 3. Provide one spare bit located in a clear plastic bag attached to the inside of each equipment rack in plain view.
 - 4. Acceptable Product:
 - a. Middle Atlantic HTX

2.26 PLATES AND PANELS

- A. General
 - 1. Provide plates and panels and as described in Drawings. Engrave as shown on Drawings. Other Plates and Panels may be required to satisfy the requirements of the Work.
 - 2. Custom panels shall be 1/8-inch thick aluminum, standard EIA sizes, brushed, anodized finish unless otherwise noted. Brush in direction of aluminum grain only.
 - 3. Plate finish shall be coordinated with the Owner. Plastic plates are not acceptable.
 - 4. Panel, plate and label engraving shall be 1/8-inch block sans serif characters unless noted otherwise. On dark panels or pushbuttons, letters shall be white; on stainless steel or brushed natural aluminum pushbuttons, letters shall be black.
 - 5. Custom and/or Engraved Panels:
 - 6. Custom panels constructed of 1/8 inch brushed aluminum
 - 7. Coordinate finishes with Owner

- B. Acceptable Manufacturers:
 - 1. EMG
 - 2. RCI Custom
 - 3. ProCo
 - 4. Radial Engineering

2.27 CONNECTORS

- A. XLR Panel mount Connectors
 - 1. Provide panel mount XLR connectors with unified metal shell.
 - 2. RF-Protector connectors.
 - 3. Shell Color: Black.
 - 4. Contacts: Silver.
 - 5. Terminations: Solder.
 - 6. Acceptable Product:

- a. Male Connectors: Neutrik NC*MD-L-1-BAG Series
 - b. Female Connectors: Neutrik NC*FD-L-1-BAG Series
- B. XLR Cable Connectors
1. Provide XLR cable connectors with die cast shell.
 2. No-screw type assembly.
 3. Chuck-type strain relief.
 4. Shell Color: Black.
 5. Contacts: Silver.
 6. Terminations: Solder.
 7. Acceptable Product:
 - a. Male Connectors: Neutrik NC*MX-BAG Series
 - b. Female Connectors: Neutrik NC*FX-BAG Series
- C. Speaker Connectors
1. Provide 4 or 8 conductor connector
 2. Shell Color: Black
 3. Terminations: Solder or tab
 4. Acceptable Product:
 - a. Neutrik NL4MPXX
 - b. Neutrik NL8MPRXX
- D. BNC Cable Connectors
1. Provide cable mount BNC connectors.
 2. Contacts: Brass or copper.
 3. Terminations: Crimp.
 4. Acceptable Product:
 - a. Kings
 - b. Amp
 - c. Amphenol
 - d. Canare
 - e. Liberty
- E. HDMI Connectors
1. Provide panel mount HDMI feedthrough connectors
 2. HDMI 2.0 compliant
 3. Acceptable Product:
 - a. Neutrik NAHDMI-W
- F. Ethercon Panel Connectors
1. Provide panel mount Ethercon CAT6 connectors
 2. Metal housing
 3. Shielded
 4. Acceptable Product:
 - a. Neutrik NE8FDP-B

2.28 LOOSE CABLES

- A. Microphone/Instrument Cables:
1. Cable properties:
 - a. Quad 24 gauge stranded with braided shield, flexible hard service jacket.
 - b. Color: Black
 - c. Each cable to be provided with a Velcro style tie wrap.
 - 1) Minimum 5/8" width
 - 2) Length appropriate to wrap minimum 1.5 times around a cable loop of 14-inch diameter.

- 3) Standard of performance:
 - a) Rip-Tie CABLEWRAP
 2. Microphone Cable:
 - a. Type 06 – 6 foot, with Gray collar on connector
 - b. Type 25 – 25 foot, with Blue collar on connector
 - c. Type 50 – 50 foot, with Green collar on connector
 - d. Type 100 – 100 foot, with Red collar on connector
 3. Instrument Cable
 - a. Type 06 - 6 foot, 1/4-1/4
 - b. Type 10 – 10 foot, 1/4-1/4
 4. Acceptable cable:
 5. Whirlwind MKQ series
 6. Canare StarQuad
 7. ProCo AmeriQuad
- B. Microphone Snake (Type 1):
1. 6 Channel
 2. Male to Female XLR connectors
 3. Acceptable Product:
 - a. WhirlwindUSA MS-6-0-NR-075
 - b. Approved Equivalent
- C. Intercom Cables:
1. Cable properties:
 - a. Quad 24 gauge stranded with braided shield, flexible hard service jacket.
 - b. Color: Yellow
 - c. Each cable to be provided with a Velcro style tie wrap.
 - d. Minimum 5/8" width
 - 1) Length appropriate to wrap minimum 1.5 times around a cable loop of 14-inch diameter.
 - 2) Standard of performance:
 - a) Rip-Tie CABLEWRAP
 2. Intercom Cable:
 - a. Type 06 – 6 foot, with Gray collar on connector
 - b. Type 25 – 25 foot, with Blue collar on connector
 - c. Type 50 – 50 foot, with Green collar on connector
 - d. Type 100 – 100 foot, with Red collar on connector
 3. Acceptable cable:
 - a. Whirlwind MKQ series
 - b. Canare StarQuad
 - c. ProCo AmeriQuad
- D. Speaker Cables:
1. Cable properties:
 - a. Color: Black,
 - b. Connector: NL4 to NL4 or NL8 to NL8
 - c. Wire: 12 gauge stranded, SJ jacket.
 - d. Each cable to be provided with a Velcro style tie wrap.
 - 1) Minimum 1" width
 - 2) Length appropriate to wrap minimum 1.5 times around a cable loop of 14-18 inch diameter.
 - 3) Standard of performance:
 - a) Rip-Tie CABLEWRAP
 2. Speaker Cable:
 - a. Type 06 – 6 foot, with Gray collar on connector
 - b. Type 25 – 25 foot, with Blue collar on connector

- c. Type 50 – 50 foot, with Green collar on connector
 - d. Type 100 – 100 foot, with Red collar on connector
 3. Acceptable cable:
 - a. Whirlwind NL series
 - b. Approved Equivalent

- E. Ethernet Audio Cables:
 1. Cable properties:
 - a. Color: Black
 - b. Neutrik Ethercon Connector
 - c. Rugged Tactical Jacket
 - d. Each cable to be provided with a Velcro style tie wrap.
 - 1) Minimum 5/8" width
 - 2) Length appropriate to wrap minimum 1.5 times around a cable loop of 14-inch diameter.
 - 3) Standard of performance:
 - 4) Rip-Tie CABLEWRAP
 2. Ethernet Cable:
 - a. Type 06 – 6 foot, with Gray collar on connector
 - b. Type 25 – 25 foot, with Blue collar on connector
 - c. Type 50 – 55 foot, with Green collar on connector
 - d. Type 100 – 100 foot, with Red collar on connector
 3. Acceptable cable:
 - a. ProCo DuraCat
 - b. Approved Equivalent

- F. Power Extension Cables:
 1. Cable properties:
 - a. Color: Black
 - b. 12-gauge, 3 conductor, stranded, flexible hard service jacket.
 - c. Each cable to be provided with a Velcro style tie wrap.
 - 1) Minimum 1" width
 - 2) Length appropriate to wrap minimum 1.5 times around a cable loop of 14-18 inch diameter.
 - 3) Standard of performance:
 - a) Rip-Tie CABLEWRAP
 2. Power Extension Cable:
 - a. Type 12 – 12 foot,
 - b. Type 25 – 25 foot,
 - c. Type 50 – 50 foot,
 - d. Type 100 – 100 foot
 3. Acceptable cable:
 - a. ProCo E-Cords series
 - b. Approved Equivalent

- G. HDMI Cable
 1. Provide pre-molded cables in lengths as required
 2. Acceptable Product:
 - a. Extron Ultra Series HDMI Cable
 - b. Comprehensive Microflex Pro AV/IT 18Gbps

2.29 INSTALLED CABLES & WIRING

- A. General

1. All electrical conductors installed under this contract, except where otherwise specified, shall be soft drawn annealed stranded copper having a conductivity of not less than 98% of pure copper, and meet appropriate ratings (e.g. CMR, CMP, etc.)
 2. Cable shall carry appropriate fire rating (e.g. CMR, CMP, OFNR, OFNP, etc.) on jacket of cable.
 3. Where cables are routed through cable tray, provide tray rated cable of equal specification.
 4. Where speaker cables are run exposed through a return air plenum, provide plenum rated cable of equal specification.
 5. Shielded cables located in raceways shall have aluminum foil shield with drain wire.
 6. The Belden cables listed below are approved for use on this project and are listed to set the acceptable standard of performance. If field conditions or actual cable pathway requires tray or plenum cable, provide version of cable that meets required rating. Cables from West Penn, Windy City Wire, Liberty, Commscope and Gepco are also acceptable provided they meet the performance specifications of the approved listed cables.
- B. Microphone/Line Level Wire
1. Provide shielded 22 AWG cable.
 2. Cable to be PVC jacketed.
 3. Jacket color: black.
 4. Acceptable Product:
 - a. Belden 9451
- C. Production Intercom Wire
1. 18 AWG shielded
 2. Cable capacitance to be less than 17 pF/ft
 3. Acceptable Product:
 - a. Belden 6340FT
 - b. Belden 9207
- D. Speaker Level Wire
1. For applications less than 300W and/or 300 feet
 2. Provide 16 AWG cable.
 3. Cable to be CL3R or CL2P rated.
 4. Jacket color: gray.
 5. Acceptable Product:
 - a. Belden 5200UE
- E. Speaker Level Wire
1. For applications less than 600W and/or 600 feet
 2. Provide 14 AWG cable.
 3. Cable to be CL3R or CL2P rated.
 4. Jacket color: gray.
 5. Acceptable Product:
 - a. Belden 5100UE
- F. Category Cable
1. 23-gauge solid cable
 2. Category 6+ Enhanced
 3. 4 pair, UTP
 4. Acceptable Product
 - a. Belden 2412F
- G. Relay/Control Level Wire
1. Provide unshielded 22 AWG cable.

2. Cable to be CMR or CMP rated.
3. Provide number of conductors where required.
4. Acceptable Product:
 - a. Belden Cable

H. Wireless /Assisted Listening Antenna Cable

1. For applications less than 100 feet
2. 16-gauge, stranded center conductor
3. RG8/X
4. 95% braided shield
5. Acceptable Product:
 - a. Belden 9258

I. Wireless /Assisted Listening Antenna Cable

1. For applications between 100 and 400 feet
2. 10-gauge, stranded center conductor
3. RG8/U
4. 90% braided shield
5. Acceptable Product:
 - a. Belden 9913

J. Extron Shielded Twisted Pair Cable

1. 22-gauge solid cable
2. S/FTP design with four shielded twisted pairs inside an overall braided shield
3. Acceptable Product
 - a. Extron XTP DTP 22 (22-285-03), plenum where required (22-286-03)

K. HDMI Cable

1. Provide pre-molded cables in lengths as required
2. Acceptable Product:
 - a. Extron Ultra Series HDMI Cable
 - b. Comprehensive Microflex Pro AV/IT 18Gbps

2.30 **BUTTONS, SWITCHES, & KNOBS**

A. Volume Controls, 70 Volt (V)

1. Provide volume control sized for connected load of speaker zone
2. Coordinate plate finish with Architect
3. Acceptable Products:
 - a. Atlas AT10 (DC)
 - b. Atlas AT35 (DC)
 - c. Atlas AT100 (DC)

2.31 **MISCELLANEOUS**

A. Relay (RLY, Type 1):

1. Acceptable Product:
 - a. RDL ST-LCR1

B. Headphones (Type 1):

1. Acceptable Product:
 - a. Sony MDR-7506
 - b. Shure SRH440
 - c. Approved Equivalent

- C. Mobile Cabinet: (Type 1) – Microphones / Accessories
 - 1. Lockable
 - 2. Steel construction
 - 3. 4 Drawers
 - 4. Large 6" casters
 - 5. Acceptable Product:
 - a. Westward 3401NVS-5PU-95W
 - b. Approved Equivalent

PART 3 - EXECUTION

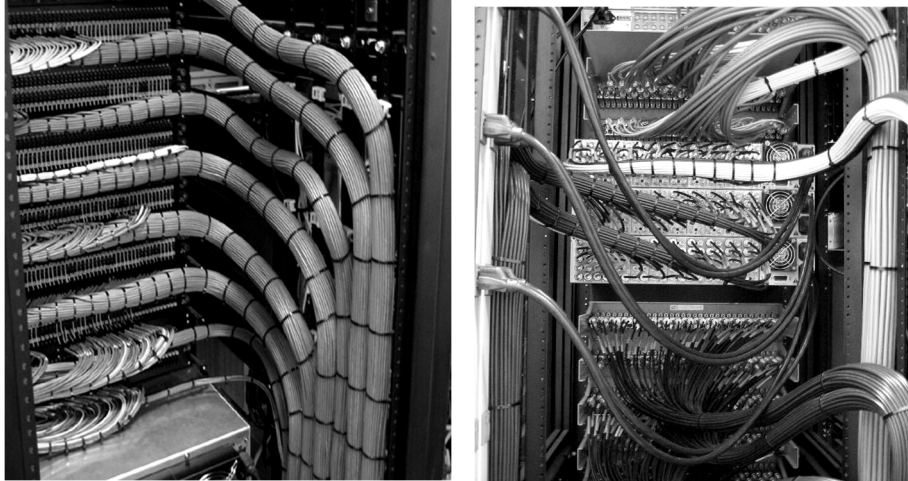
3.1 GENERAL

- A. Coordinate incorporation of the Work specified herein with other project work so as to facilitate a cohesive final Products.
- B. The installation recommendations contained within ASDI and Telecommunications Distribution Methods Manual are mandatory minimum standards and requirements.
- C. Mount equipment and enclosures plumb and level.
- D. Permanently installed equipment to be firmly and safely held in place. Design equipment supports to support loads imposed with a safety factor of at least five. Seismic bracing shall be installed on appropriate equipment where local codes require such installation.
- E. Verify all locations of equipment in all rooms with Owner's Representative, Owner, and Consultant.

3.2 INSTALLATION

- A. Installation of cable and wiring
 - 1. Cabling and Wiring:
 - a. Install cable in a manner to adhere to manufacturer's specifications for maximum cable pulling tension, minimum bend radius, and restrictions.
 - b. Provide appropriate support at all horizontal-to-vertical transitions in order to keep the weight of the cable from degrading at the point of transition.
 - c. If a J-hook or trapeze system is used to support cable bundles, all horizontal cables shall be supported at a maximum of 48-inch (1.2 meter) intervals. At no point shall the cables rest on light fixtures, acoustic ceiling grids, panels, conduits, sprinkler pipe, water pipe and/or HVAC system ducting.
 - d. Horizontal distribution cables shall be bundled in groups of no more than 50 cables when being supported by J-Hook or trapeze systems. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance. An exception to this rule is when cable is installed in cable tray systems.
 - e. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices
 - f. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, install appropriate carriers to support the cabling.
 - g. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced prior to final acceptance at no cost to the Owner.
 - h. Cables shall be identified by a self-adhesive machine label in accordance with the System Documentation Section of this specification and ANSI/TIA/EIA-606-A. The

- cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
- i. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
 - j. Provide splice free wiring and cabling from origination to destination. Cables shall be installed in continuous lengths from origin to destination (no splices). Properly designed transition points, or consolidation points are not considered 'splice' points.
 - k. Make joints and connections with rosin-core 60/40 solder or with mechanical connectors specifically intended for the type and class of cable being used. Where spade lugs are used, crimp properly with ratchet type tool.
 - l. Take precaution to prevent and guard against electromagnetic and electrostatic hum. For line-level audio signal, float cable shield at one end. Shield not connected to be folded back over cable jacket and covered with heat-shrink tubing. Do not cut off unused shield.
 - m. Isolate cables and wires of different signals or different levels; and separate, organize, and route to restrict channel crosstalk or feedback oscillation in any amplifier section. Keep wiring separated into groups for microphone level circuits, line level circuits, loudspeaker circuits, and power circuits.
 - n. Connect cable to active components through XLR connections whenever multiple formats are available. Make connections to speaker transformers with properly sized closed end connectors crimped with factory approved ratchet type tool. Wire nut or "Scotchlock" connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape.
 - o. Cover edges of cable and wire pass-through holes in chassis, housings, boxes, etc., with rubber grommets or Brady GRNY nylon grommetting.
 - p. Execute wiring in strict adherence to:
 - 1) Phillip Giddings. Audio System Design and Installation. Indianapolis: Howard W. Sams & Co., 1990.
 - 2) Don Davis and Carolyn Davis. Appendix II, Recommended Wiring Practices. Sound System Engineering, 2nd Edition. Indianapolis: Howard W. Sams & Co., 1989.
 - 3) AV Installation Handbook Second Edition: The Best Practices for Quality Audiovisual Systems, Infocomm, 2009
2. Equipment Housing Cabling and Wiring:
- a. Lace, tie, or harness wire or cable as required herein, and in accordance with accepted professional practice. Dress, lace or harness all wire or cable to prevent mechanical stress on electrical connections; no wire or cable shall be supported by a connection point. Install cable and wire neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Reference photos below for standard of quality.



- b. Provide adequate service loops so that equipment mounted on rack slides may be pulled fully out, to their locked position without straining cable.
 - c. Neatly bundle excess AC power cable from housing mounted equipment with plastic cable ties.
 - d. Provide plastic cable ties or Velcro straps to bundle cabling and wiring. Electrical tape and adhesive backed cable tie anchors are not acceptable.
 - e. Install with connections completely visible and labeled.
 - f. Provide termination resistors, if required, of 5 per cent tolerance; fully visible and not concealed.
- B. Installation of connectors, plates & panels:
1. Install panel mounted connectors rigidly attached to panels, plumb and level.
 2. Custom rack panels shall be 1/8 inch thick aluminum, standard EIA sizes, brushed black anodized finish (brushed in direction of aluminum grain only), unless otherwise noted.
 3. Custom connector plates (speaker, microphone, etc.) are typically stainless steel, unless otherwise noted or specified. However, verify plate finish with Architect.
 4. Install XLR type connectors in accordance with IEC-268 standard, with a wiring scheme of pin 2 hot (high), pin 3 (low), and pin 1 screen (shield).
 5. Other Plates and Panels may be required to satisfy the requirements of the Work.
- C. Installation power and grounding:
1. Coordinate final connection of power and ground wiring to housings.
 2. Hardwire power wiring directly to internal AC receptacles to ensure uninterrupted operation.
 3. Provide 3-conductor, isolated ground, 120 VAC outlets as required within each housing. Provide a minimum of two spare outlets in each rack.
 4. Provide a copper ground buss top to bottom in each housing, insulated from the housing. Ground equipment chassis not having a three wire power cord to these busses using 6/32 nuts, bolts and lock-washers with No. 12 wire. Connect green ground wire from each AC outlet in housing to this buss bar.
 5. Replace manufacturers supplied 18 gauge IEC power cords with UL listed 18 gauge pre-molded 6", 12", 18", or 24". Use minimum length required. No looped or cable tied IEC power cords will be permitted within the equipment rack.
 6. Replace manufacturers supplied 14 gauge IEC power cords with UL listed 14 gauge pre-molded 18" or 36" for all equipment IEC capable. Use minimum length required and minimize looped or cable tied IEC power cords present in the equipment rack.
- D. Installation of electronic equipment:

1. Take appropriate precautions against electrostatic discharge (ESD). Establish a personal ground before handling electronic equipment through the use of a grounded wrist wrap and/or an anti-static floor pad.
 2. Take appropriate precautions to protect the equipment from damage during installation. Equipment to be installed free of damages, scratches, dents, etc.
 3. Mount trim potentiometers, custom circuit cards, relays, and transformers (except large 70V units) in shielded enclosures, and mark their function and connections with engraved lamicoid labels.
 4. Mount equipment plumb and level, firmly and safely held in place.
- E. Installation of equipment housing:
1. Mount equipment in racks and consoles and fully wire and test before delivery to job site. If field conditions prevent prior assembly of racks, notify Owner in writing that racks will be fabricated on site and the reasons for the change.
 2. Secure rack mounted devices utilizing all available fastener mounting positions on device.
 3. Provide rear support for housing mounted equipment greater than 15 inches deep.
 4. Provide blank panels to fill unused panel space within the equipment housing.
 5. If Key door locks are required, key each housing type alike.
 6. Looking at the rack from the rear, locate AC power and speaker wiring on the left; line level audio, video, and RF wiring on the right.
 7. Provide shaft locks or security covers on non-user operated equipment having front panel controls. These panels are to be installed at the conclusion of testing.
 8. If forced air active thermal management is used, provide ventilation blocking material on the front, sides, and rear of the equipment rack as needed. Reference Middle Atlantic Products "Controlling the Temperature Inside Equipment Racks".
 9. Panels or equipment mounted on the rear rack rails shall not block access to any front mounted components.
 10. If equipment rack is not equipped with casters, provide two inch high wood base to isolate equipment rack from floor. Wood base should be capable of supporting the load.
- F. Installation of loudspeakers:
1. The Contractor is responsible for final design and engineering of loudspeaker rigging, attachments, brackets, and hoisting.
 2. Loudspeakers shall be mounted at the operating position in a safe, secure, and permanent manner.
 3. Provide custom rigging as needed. In addition to the ANSI standards below, custom rigging shall be built to include compliance with the following American Welding Society standards:
 - a. AWS-D1.1/D1.1M:2020
 - b. AWS-D1.2/D1.2M:2014
 4. Loudspeaker manufacturer supplied mounting brackets or rigging shall be built to the applicable ANSI standards listed below, with testing and/or traceability data provided as part of shop drawings submittal.
 5. Suspension and Mounting:
 - a. Static and dynamic equipment loads shall be suspended or mounted in compliance with the following ANSI/ESTA standards, using the latest available versions of the standards:
 - 1) ANSI E1.4-2-2021 Statically Suspended Rigging Systems
 - 2) ANSI E1.56-2018 Rigging Support Points
 - 3) ANSI E1.6-1-2021 Powered Hoist Systems
 - 4) ANSI E1.8-2012 Loudspeaker Enclosures Intended for Overhead Suspension
 - b. Rigging, mounting, and support systems for overhead suspended loudspeakers shall be reviewed and certified by a registered Professional Engineer (PE), in the employ of the Contractor, licensed to practice in the State in which the project is

located. Documentation shall be included as a submittal item. Once the systems are installed, the PE shall physically inspect, at the Contractor's cost, the methods and means used to verify compliance with the original design.

6. General Guidelines:
 - a. Reference Project structural documents.
 - b. Site and/or special inspections may be required if requested by the Owner.
 - c. Paint loudspeakers, supports, and related hardware color as directed by the Owner.
 - d. The aiming direction of all loudspeakers shall be adjustable by no less than ± 5 degrees horizontally and vertically.
 - e. Loudspeakers are to be oriented parallel to their mounting surface unless otherwise noted.
 - f. Provide a safety cable connected to a secondary location for each loudspeaker.
 - g. All loudspeakers located in ceiling tiles shall be located in the center of the tile unless noted otherwise.
 - h. Paint loudspeakers to match surroundings. Confirm color selection with the Architect during the submittal phase.
 - i. Exterior loudspeaker cabinets shall be constructed of materials designed for permanent outdoor exposure conditions with a minimum IP 54 rating, and a minimum expected 10-year life span. Exterior and interior surfaces of the cabinets shall be protected from the effects of water, moisture, and humidity. The exterior surface shall also be protected from the effects of ultraviolet radiation to prevent fading and color change. The cabinets shall be shaped and oriented in a manner that minimizes the possibility of water pooling on any cabinet surface. Associated hardware shall be inherently non-corrosive, performing to the standards of 304 Stainless Steel or higher.

- G. Installation of projectors:
 1. Confirm distance of specified projection lens before mounting projector.
 2. Projectors shall be mounted plumb and level at the operating position in a safe, secure and permanent manner.
 3. All hardware required to locate the mount and projector at the required location shall be provided.
 4. Projectors shall be mounted using tamper proof secure hardware.
 5. Contractor may be required to adjust projection screen and lift upper and lower limit switches for projection screens and lifts specified elsewhere and not installed as part of this Contract.

- H. Installation of flat panel monitors:
 1. Confirm location before mounting.
 2. Monitors shall be mounted plumb and level at the operating position in a safe, secure and permanent manner.
 3. All hardware required to locate the mount and monitor at the required position shall be provided.
 4. Locate monitor on the center line of the room unless noted otherwise.

- I. Loose Equipment
 1. Provide loose equipment as indicated on drawings.
 2. Unpackage and assemble items.
 3. Place items in designated storage or refer to Owner for direction on final location and storage of loose equipment.

3.3 FIRESTOP

- A. A fire-stop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the

penetrated structure. Fire-stop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.

- B. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate fire-stop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire-stopped.
- C. Fire-stop systems shall be reviewed by a Professional Engineer (PE) licensed to practice in the State in which the project is located. Stamped drawings showing the fire stop systems shall be included as a submittal item. Once the systems are installed, the engineer of record for the firestop system shall physically inspect the methods and means used to verify compliance with the original design.
- D. A drawing showing the proposed fire-stop system, stamped/embossed by the PE shall be provided to the Owner's Technical Representative prior to installing the fire-stop system(s).
- E. All fire-stop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for observation by the local authorities prior to cable system acceptance.

3.4 CONTROL SYSTEM PROGRAMMING

- A. General
 - 1. Audio level controls
 - a. Audio level controls to use UP/DOWN buttons to change audio levels in 2 dB increments (or closest translation by control system).
 - b. Microphone and line level controls to have a fixed range between 0 and -24 dB.
 - c. Audio outputs/zone output level controls to have a fixed range between 0 and -6 dB.
 - d. Provide visual feedback of current level setting.
 - e. Provide additional level control upstream of user-level control to set the overall level for each zone.
 - 2. Audio System with power sequencing definitions:
 - a. STANDBY: System is powered on with all outputs muted in processing.
 - b. MODE: See individual systems for exact routing in each mode. System is on and outputs are unmuted in processing.
 - c. OFF: System is powered down with all outputs muted in processing.
- B. Black Box
 - 1. Low voltage controls by control system
 - a. Power Sequencing
 - 1) Power Up: Triggered by control system via touch panel SYSTEM ON button, Control system to begin System Power Up Sequence. Sequence to be timed to trigger sequencing systems in accordance with the sequence specified in Power Sequencing Systems in this specification. During Sequence, Control System to flash the SYSTEM ON button on touch panel until sequence is complete. Upon completion, Control System to indicate that the system is powered on and ready via solid color on SYSTEM ON button on touch panel.
 - 2) Power Down: Triggered by control system via touch panel SYSTEM OFF, Control system to begin System Power Down Sequence. Sequence to be timed to trigger sequencing systems in accordance with the sequence specified in Power Sequencing Systems in this specification. During Sequence, Control System to flash the SYSTEM OFF button on the touch

panel until sequence is complete. Upon completion, Control System to indicate that the system is powered off by solid color on SYSTEM OFF button on touch panel.

2. DSP functions triggered by AV Control System touch panel
 - a. LOBBY VOLUME: Volume control for Lobby feed.
 - b. LOBBY MUTE: Mute control for Lobby feed.
 - c. RESTROOM VOLUME: Volume control for Lobby Restroom feed.
 - d. RESTROOM MUTE: Mute control for Lobby Restroom feed.
 - e. BOH VOLUME: Volume control for Back-of-House corridor feed.
 - f. BOH MUTE: Mute control for Back-of-House corridor feed.
 3. DSP functions triggered by AV Control System touch panel located in Light Lock
 - a. Volume controls: Provide volume controls for sources shown in DSP diagram.
 - b. Mute controls: Provide mute controls for sources shown in DSP diagram.
 - c. LOBBY VOLUME: Volume control for Lobby feed.
 - d. LOBBY MUTE: Mute control for Lobby feed.
- C. Transport Control
1. Provide standard Stop, Play, Pause, Fast Forward and Rewind for each playback device and menu control for DVD players. Buttons should be arranged in a conventional fashion that will be familiar to the normal user.
 2. The selected control function should be displayed by showing the appropriate button “pressed”. It should remain this way until another function is selected.
 3. For devices that will go into a standby mode after a period of time, the control system shall sense this mode and restore normal operating mode once a transport function has been selected. This may require the use of current sensors to determine the state of the unit. No direct user action should be required at the playback device to restore the normal operating mode.
- D. Screen/Shade Control
1. In addition to up-down functions, provide a Stop function to allow the movement to be halted. Once movement has been stopped, the up or down buttons should resume travel in the selected direction.
 2. Control system shall not prevent screen/shade wall controls from being used as well.
 3. Touch panel controls should be readily accessible to the user to permit direct control of shades or screen with having to navigate through multiple control pages.
- E. Level Control
1. Objects requiring level adjustment such as volume or tone controls shall be through Up/Down buttons with a graphical representation of the actual level.
 2. Increment of level change to be adjusted for reasonable range without the need to push the Up or Down buttons needlessly.
- F. Volume Mute
1. Where the ability to mute the sound is needed, the button shall use the label “Vol On” and “VOL OFF” instead of Mute and Unmute. When in a “VOL OFF” mode, pushing the “VOL UP” button shall restore the sound and bring the system out of the muted mode.
 2. VOL ON/OFF buttons shall change color to indicate the status of the button.
- G. Standard Colors
1. Control functions shall be color coded to add clarity and show relationships between different groups of controls.
 2. The color Red shall be reserved to indicate a fault or abnormal condition.
 3. Green may be used to indicate normal operation, but may be used for standard control colors as well.
 4. Similar controls should maintain the same color scheme across all control pages.

5. When a function is selected, the graphical depiction of that button should appear to be pressed and its color change to a darker shade of the regular button color.
 6. Color schemes used for background and foreground objects should be selected to be complimentary and provide a consistent theme throughout the control pages.
- H. Minimum Button Size and Placement
1. Minimum visual size of a button is 3/8" wide by 1/4" high.
 2. Spacing between buttons should be no less than 1/16".
 3. Where buttons are immediately adjacent, the active selection area of the button should be reduced to 80% of the visual area of the button.
- I. Button Actions
1. When a function on a control page is selected, that button or visual object associated with that function should change to reflect what has been chosen.
 2. For functions that are momentary selections (i.e., VOL UP), the change of state is visible for as long as the button is being pressed.
 3. For function that are maintained selections (i.e., PLAY), the change of state remains visible until another function is selected and resets the previous function.
 4. The state change of a button or visible object should depict real-world objects as much as possible including the appearance of the button be pressed inward, change in shade of the original color, but not a change in hue.
- J. Labels
1. Use of simple words or titles are preferred to indicate functionality, navigation and system status.
 2. Use of stylish symbols should be avoided unless their identity is commonly recognized by the general public. Standard symbols for transport functions are acceptable.
 3. Labels should be presented in a clear, sans serif type face that will remain legible on lower resolution touch panels.
 4. Where physical buttons are present along the side of a touch panel, these buttons should be engraved and filled with a contrasting color.
- K. Power On/Off
1. For panels requiring an ON/OFF control, these functions should be linked through current sensors or other methods for the control system to detect the power on condition of the component being controlled.
 2. Powering off a system should not interfere with the ability of a projector to complete its cool down cycle.
- L. Look & Feel
1. Control pages should utilize a clean, elegant but stylish appearance.
 2. Use a common graphical template across all control pages for a consistent look.
 3. The touch screen layout should utilize graphical elements such as drop shadows, gradient fills and transparency to provide a pleasing overall appearance.
 4. Utilize graphical representations of floor plans to convey location information.
 5. Include company logos, icons or watermarks to portray the corporate identity.
 6. Provide clear navigation tools for moving between control pages.
 7. Each sub-page should have a "BACK" button to return to the previous page. This button should appear in the same location on each page.
 8. Provide a "HELP" button or icon on each user page to provide clear, non-technical instructions on how to use the functions available to regular users.
- M. Security
1. Provide password access to control pages not intended to be accessed by the general public.
 2. Unless otherwise noted, provide a minimum of three levels of access

- a. General User
 - b. Non-Technical Employee
 - c. AV Technician
3. Segregate the control functions to only allow authorized individuals access to more sophisticated control pages.
 4. Provide a timeout feature to automatically return the control panel back to the default opening screen after 30 seconds of inactivity. After this reset, passwords must be reentered to return to a previous control page.

N. Presets

1. For systems that have different operating modes or configurations, provide the ability to store and recall preset combinations of system settings.
2. Provide a "Preset" page that permits a minimum of five presets to be recalled. Each button to include a label describing the function or configuration associated with that button.
3. Provide the ability for new presets to be stored over previous settings. New preset to be able to change the label to reflect the new or revised configuration.
4. When a preset has been recalled, the control page should indicate the active configuration.

3.5 LABELING OF EQUIPMENT

- A. Provide each terminal strip with a unique descriptor and a numerical designator for each terminal. Show terminal strip descriptor and designator on system schematic drawing.
- B. Provide logical and legible cable and wiring label permanently affixed for easy identification.
 1. Labels on cables to be adhesive strip type covered with clear heat-shrink tubing. Factory stamped heat shrink tubing may be used in lieu of the adhesive strip style.
 2. Wiring designator to be an alpha-numeric code unique for each cable. Actual cable designation assignments to be determined by Contractor. Add cable designation codes to system schematic drawings.
 3. Locate the cable designator at the origination and destination of each circuit within 3 inches of the point of termination or connection. Provide cable designator on circuits with intermediate splice points with an additional suffix to indicate each segment.
- C. Conform with AVIXA Cable Labeling for Audiovisual Systems
 1. AVIXAF501.01:2015

3.6 ENGRAVING

- A. Text font: 1/8 inch block sans serif characters unless noted otherwise.
- B. On dark materials, provide white characters; on stainless steel or brushed natural aluminum plates, or light-colored materials, provide black characters.
- C. Provide at least two lines of text with first line listing the general device name, e.g., amplifier. Second line to include schematic reference of the device, e.g., AMP-1.
- D. Equipment label: black with white characters except where indicated.

3.7 COMMISSIONING

- A. Prior to energizing or testing the system, ensure the following:
 1. All products are installed in proper and safe manner according to manufacturer's instructions.

2. Insulation and shrink tubing are present were required.
 3. Dust, debris, solder splatter, etc. is removed.
 4. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
 5. Labeling has been provided.
 6. Temporary facilities and utilities have been properly disconnected, removed and disposed of off-site.
 7. Products are neat, clean and unmarred and parts securely attached.
 8. Broken work, including glass, raised flooring and supports, ceiling tiles and supports, walls, doors, etc. have been replaced or properly repaired, and debris cleaned up and discarded.
- B. Prior to energizing the System verify and perform the following tests and adjustments in compliance with applicable EIA standards.
1. Electronic devices are properly grounded.
 2. Test each AC power receptacle with a circuit checker for proper hot, neutral and ground connections.
 3. Verify each individual component is operating properly.
 4. Verify each individual component's performance meets the manufacturer's published performance for this unit.
 5. Measure and record the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be 0.15 ohms or less.
- C. Speaker Circuit Verification Test
1. Measure the impedance of each speaker line leaving the equipment racks.
 2. For constant voltage systems measure the impedance at 100 (or 250) Hz, 1 KHz and 8 (or 10) KHz of each line leaving the equipment rack with the line disconnected from the driving source. For band limited devices, use a frequency appropriate for the operating range of the transducer.
 3. When documenting the results of these tests, include the calculated impedance based on number of units on a line and the size and distance of the run. Correct any field readings that differ more than 20% from the calculated impedance.
 4. Include the results of the tests in the Project Record Manual.
- D. Speaker Polarity Verification Test
1. Use an electronic polarity checker, TEF-20, SYSID, SIM II, Smaart, or other similar device to test each loudspeaker. All speakers should have the same relative polarity.
 2. Follow manufacturer's recommendations in conducting the tests.
 3. Include the results of the tests in the Project Record Manual.
- E. Audio Signal Paths
1. Verify operation from each source device through all switching, amplification and distribution devices.
- F. System Gain Adjustment
1. Adjust each active device to have proper gain structure from the mixer output to the input of the amplifier.
 2. With all amplifiers turned off, connect a sine wave or pink noise generator to the input of the mixer. Using an RMS AC voltmeter with a dB scale, adjust the mixer to an output between -10 and 0 dBu. Once the level has been established, it should remain unchanged throughout the test. All equalizers should be set flat for this test.
 3. Follow the signal flow from the mixer to each subsequent component. Measure the input level and output level of each device at the point of connection to the device. The input level reading should differ no more than 0.25 dB from the level recorded for the preceding device. Diagnose and correct the wiring or equipment when any readings exceed this range.
 4. Adjust the output of each component to achieve the proper output level.

5. Record the output levels of each device in the Project Record Manual.
- G. Signal Delay Adjustment
1. Adjust the delay to each subsystem to ensure proper synchronization between the main speakers and delayed speakers.
 2. Using a TEF 20, SYSID, Smaart, SIM II, or other acceptable time based measurement system, measure the arrival time of the distant signal and then measure the arrival of the local signal.
 3. Based on the arrival times measured, adjust the delay applied to the local speakers to synchronize them with the distant speakers. Repeat the test to verify the delay has been set to within 1 ms of the arrival of the distant signal. Once the precise delay time has been determined, provide an additional 10 ms of Haas effect delay to maintain directional orientation toward the original sound source.
 4. Continue to test and adjust each separate subsystem with a dedicated delay channel.
 5. Provide hard-copy printout of each delay adjustment showing first the arrival times with no delay set and then the result after the delay has been adjusted. Record the settings of each delay in the Project Record Manual.
- H. Remote Input Verification Test
1. Using a microphone or portable signal generator, connect to each microphone/line level receptacle throughout the facility.
 2. Verify that the receptacle under test appears at the correct input and is operating properly.
 3. In a similar manner, check all remote tielines and media related lines for correct wiring and labeling.
- I. System Equalization
1. Using a RTA, TEF 20, SYSID, or SMAART, equalize all loudspeaker systems to provide a suitable frequency response as follows:
 - a. Speech Reinforcement Systems: flat response from 125 Hz to 2.5 KHz, with 2 dB roll off above.
 - b. Program Reproduction Systems: flat response from 65 Hz to 8 KHz, with 2 dB roll off above.
 2. Verify system gain and amplifier levels.
 3. Provide program levels of at least 85 dB and speech reinforcement levels of at least 70 dB in the seating area without objectionable distortion, buzzes, or rattles.
 4. Provide hard copy printouts of the spectral response with the test data.
- J. RFI and Parasitic Oscillation
1. With systems operating check to ensure that all systems are free from spurious oscillation and radio frequency interference in the absence of audio signal.
- K. Buzzes, Rattles and other Distortions
1. Adjust the system for normal operating level in the space. Apply a slow sine wave sweep from 60 Hz to 3 KHz and listen carefully for buzzes, rattles and other objectionable distortions.
 2. Correct the cause of the defect. If the cause is not from the system. Bring the cause to the attention of the GC, indicating cause and suggestive corrective actions.
- L. Video Systems Test
1. Projected images and screen must be plumb with respect to ceiling line.
- M. Video System Tests. Verify performance of all video equipment, components and systems, as specified herein.
1. Video (signal):
 - a. S/N (peak to RMS), unweighted DC to 4.2 MHz: 55 dB minimum.

- b. Crosstalk, unweighted DC to 4.2 MHz: 45 dB minimum.
 - c. Frequency Response: Within plus to minus 0.5 dB to 4.2 MHz.
 - d. Line and Field Tilt: 2% maximum.
 - e. Differential Gain: 2% maximum.
 - f. Differential Phase: 2 degrees maximum.
 - g. Frequency Response: DC to 4.2 MHz within plus or minus 0.5 dB.
- N. Video Signal Paths
- 1. Verify operation from each source device through all switching, amplification and distribution devices.
- O. Video Test Report shall include the following:
- 1. Test Failures and Notices
 - a. Sink Device EDID Test – Open items or failures shall not be accepted.
 - b. Cable Length Test – Open items or failures shall not be accepted.
 - c. HDCP KSV Limitations – Limitations shall not be accepted.
 - d. Cable Limitations - Limitations shall not be accepted.
 - e. EDID Limitations - Limitations shall not be accepted.
 - f. Cable Length Limits exceeded – Failing cables shall not be accepted.
 - 2. Device Model Number, Serial Number, and Firmware Version for main chassis and each input and output card.
 - 3. Device Model Number, Serial Number, and Firmware Version for connected transmitter and receiver devices.
 - 4. EDID – Input Resolution and 3D support status for each input.
 - 5. EDID – Supported Output Resolution and 3D support status for devices connected to each output.
 - 6. EDID – Supported Audio formats for each input.
 - 7. EDID – Supported Audio formats for devices connected to each output.
- P. Control Systems
- 1. Verify operational functions of the control system and all interfaced devices.
 - 2. Verify operational functionality of any wireless user devices.

3.8 CAT5E/CAT6 CABLE CERTIFICATION

- A. General Field Test Requirements
- 1. All CAT5E/CAT6 cabling links installed as part of this scope shall be tested for the following, in accordance with the field test specifications defines in ANSI/TIA-568-C.2 “Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard.” This document will be referred to as the “Category 5e Standard”:
 - a. Wire Map
 - b. Length
 - c. Insertion Loss
 - d. NEXT loss
 - e. PS NEXT Loss
 - f. ACR-F Loss
 - g. PS ACR-F Loss
 - h. Return Loss
 - i. Propagation Loss
 - j. Delay Skew
 - 2. The installed twisted-pair horizontal links shall be tested from terminated end point to terminated end point for compliance with the “Permanent Link” performance specification as defined in the Category 5e Standard.
 - 3. One hundred percent of the installed cabling links must pass the requirements of the Category 5e standard mentioned above and as further detailed in Section B below. Any failing link must be diagnosed and corrected. The corrective action shall be followed with

a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with Section C below.

4. The test equipment (tester) shall comply with the accuracy requirements for level IIe field testers as defined in ANSI/TIA-1152. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 2 of ANSI/TIA-1152 (Table 2 in this TIA document also specifies the accuracy requirements for the channel configuration).
5. The RJ45 test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.
6. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
7. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
8. The Pass or Fail condition of the link-under-test is determined by the results of the required individual tests (detailed in Section 4.2.2 of ANSI/TIA-1152). Any Fail result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass.
9. A Pass or Fail result for each parameter is determined by comparing the measured values with the specifies test limits for that parameter.

B. Performance Test Parameters

1. The test parameters are defined by the Category 5e Standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test, all measurements (at each frequency in the range from 1 MHz through 100 MHz) must meet or exceed the limit value determined in the above mentioned standard.
2. Wire Map - Shall report Pass if the wiring of each wire-pair from end to end is determined to be correct.
3. Length – The field tester shall be capable of measuring length of all pairs of a basic link or channel based on the propagation delay measurement and the average value for NVP. The physical length of the link shall be calculated using the pair with the shortest electrical delay. This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.
4. Insertion Loss (Attenuation) – Insertion Loss is a measure of signal loss in the permanent link or channel. The term “Attenuation” has been used to designate “Insertion Loss.” Insertion Loss shall be tested from 1 MHz through 100 MHz in maximum step size of 1 MHz. It is preferred to measure insertion loss at the same frequency intervals as NEXT loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk Ratio (ACR) parameter. Minimum test results documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results of the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which the worst case value occurs, and the test limit value at this frequency.
5. NEXT Loss – Pair-to-pair near end crosstalk loss (abbreviated as NEXT loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through 100 MHz. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT loss measurements shall not exceed the maximum step size defined in the Category 5e

Standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst value of NEXT (worst case). NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

Table 1 – Maximum frequency step size as defined in ANSI/TIA-1152

Frequency Range (MHz)	Maximum Step size (MHz)
1 - 31.25	0.15
31.26 - 100	0.25

6. PS NEXT Loss – Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link under-test (a total of eight results). PS NEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when all other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 through 100 MHz and the step size may not exceed the maximum step size defined in the Category 5e Standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS next. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
7. ACR-F Loss, pair to pair – Attenuation Crosstalk Ratio Far-end is calculated from the pair-to-pair FEXT Loss. It shall be measured for each wire-pair combination from both ends of the link under-test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ACR-F Loss that must be evaluated and reported in the test results. ACR-F measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ACR-F is to be measured 1 through 100 MHz and the maximum step size for FEXT loss measurements shall not exceed the maximum step size defined as the standard as in Table 1. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst value for ACR-F. There wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
8. PS ACR-F Loss – Power Sum Attenuation Crosstalk Ratio Far-end is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs of the fourth one. This test yields eight wire-pair combinations. Each wire-pair is evaluated from 1 through 100 MHz in frequency increments that do not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
9. Return Loss – Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through 100 MHz in frequency increments that do not exceed the maximum step size defined in the Category 5e Standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst value of Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.
10. Propagation Delay – Propagation delay is the time required for the signal to travel from one of the links to the other. This measurement is to be performed for each of the four wire pairs. Minimum test results documentation (summary results): Identify the wire pair

with the worst propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

11. Delay Skew – [as defined in the Category 5e Standard; Section 6.2.19] This parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay (the longest propagation delay). The report shall include the delay skew value measured as well as the test limit value.

C. Test Result Documentation

1. The test results/measurements shall be transferred into a Windows based database utility that allows for the maintenance, inspection, and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test and that these results cannot be modified at a later time.
2. The database for the completed job shall be stored and delivered on CD-ROM or DVD including the software tools required to view, inspect, and print any selection of test reports.
3. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information:
 - a. The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - b. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number.
 - c. The date and time the test results were saved in the memory of the tester.
4. General information to be provided in the electronic data base with the test results information for each link:
 - a. The identification of the customer site as specified by the end-user.
 - b. The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - c. The overall Pass/Fail evaluation of the link-under-test
 - d. The name of the test limit selected to execute the stored test results
 - e. The cable type and value of NVP used for length calculations
 - f. The date and time the test results were saved in the memory of the tester
 - g. The brand name, model, and serial number of the tester.
 - h. The identification of the tester interface
 - i. The revision of the tester software and the revision of the test limits database in the tester
 - j. The test results information must contain information on each of the required test parameters that are listed in Section B and as further detailed below under paragraph C5.
5. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. The PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
6. The detailed test results data to be provided in the electronic database must contain the following information:
 - a. Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m330 and test limit value.
 - b. Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value.
 - c. Delay Skew: Identify the pair with the largest value for delay skew, the value measured in nanoseconds (ns) and the test limit value.

- d. Insertion Loss (Attenuation): Minimum test results documentation as explained in Section B for the worst pair.
- e. Return Loss: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link.
- f. NEXT, ACR-F: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link.
- g. PS NEXT and PS ACR-F: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link.

3.9 FINAL OBSERVATION & TESTING

- A. Upon completion of installation, initial adjustments, tests and measurements specified in Part 3, and submission and review of the results, a final observation and test will be performed by the Owner or Owner's representative no earlier than two weeks after receipt of the written results.
- B. Provide a minimum of one (1) person for observation and testing familiar with aspects of the System to assist the Owner.
- C. The process of testing the System may necessitate moving and adjusting certain components.
- D. Testing includes operation of each major system and any other components deemed necessary. Perform tests and provide required test equipment, tools and material required to make any necessary repairs, corrections, or adjustments.
- E. The following procedures will be performed on each System:
 - 1. Observation of the methods and means employed to incorporate the System within the facility.
 - 2. Verification of proper operation, from controlling devices to controlled devices.
 - 3. Verification of proper adjustment, balance, and alignment of equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control, and appropriately record these settings within the Record Documents.
 - 4. Other tests on equipment or systems deemed appropriate.
- F. In the event the need for further adjustment or work becomes evident during testing, the Contractor is to continue their work until the System is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or installation to meet the requirements of these specifications and any extension of the observation and testing period is required, the Contractor shall pay for additional time and expenses of the Owner at the standard rate in effect at that time.

3.10 TEST EQUIPMENT

- A. Thirty days prior to start of testing, provide a list to the Owner of test equipment make, model numbers and calibration dates that will be used.
- B. The following equipment shall be available on site for the entire test period through final system testing.
 - 1. Sound Level Meter : ANSI S1.4-1971 Type S1A with digital or analog display. Meter to provide ranges of 40 to 120 dBA.
 - 2. Pink Noise Source - Equal energy per octave bandwidth 20 Hz to 20,000 Hz, ± 1 dB (long-term average) at 0 dBm output. Stability: ± 2 dB per day.
 - 3. Dual-trace oscilloscope - 100 MHz bandwidth, 1 mV/cm sensitivity.
 - 4. Impedance Meter - Capable of testing audio lines at three frequencies, minimum, between 250 Hz and 5k Hz. Measurement Range: 1 ohm to 100 kohms.

5. Audio Oscillator: bandwidth 20 Hz to 20k Hz \pm 5 dB at 0 dBm output. Output to be balanced. Oscillator to include adjustable output level over the range from -30 dBu to $+10$ dBu.
 6. Multimeter - Measurement range, DC to 20k Hz, 100 mV to 300 V, 10 ma to 10 A, dB.
 7. NTSC Test generator
 8. Real time analyzer with LED or CRT display. The unit shall meet the filter requirements of ANSI S1.11 Class III for one third octave filters.
 9. Video (analog) test generator capable of generating signal up to 1920 x 1200 with audio.
 10. Video (digital) test generator capable of generating signal up to 1920 x 1200 with audio.
 11. Ladders and scaffolding necessary to inspect elevated equipment, junction boxes, etc.
- C. Provide three portable VHF or UHF business band radios for use during acceptance testing with transmission range sufficient to cover entire project. Include rechargeable batteries and recharger along with holster for wearing on belt. Radios to be available for duration of testing process, including any follow-up visits required prior to final acceptance.

3.11 INSTRUCTION OF OWNER PERSONNEL

- A. Provide instruction to Owner designated personnel focusing on the use, operation and maintenance of the systems, scheduled as a minimum of two separate sessions, by an instructor fully knowledgeable and qualified in system operation. The System Reference Manuals should be complete and on-site at the time of this instruction. Coordinate the schedule of the demonstration with the Owner's Representative.
1. Black Box
 - a. 4 hours of instruction
- B. Video record all training sessions and compile a training video to be provided to the Owner on DVD.
- C. Provide sign in sheet to document the attendee's presence.
- D. If the Contractor is not properly equipped to conduct Owner training on particular equipment, arrange for factory representatives of the equipment to be present to provide training at no additional cost to the Owner.

3.12 CLEANUP AND REPAIR

- A. Upon completion of the work, remove refuse and rubbish from and about the premises. Leave areas and equipment clean and in an operational state. Repair any damage caused to the premises by the installation of systems at no cost to the Owner.

END OF SECTION 27 41 16

SECTION 27 51 33 – TWO-WAY COMMUNICATIONS SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Two-way emergency communication system for accessible means of egress, including related infrastructure and functional requirements (addressing CBC Section 1007.8 {and subparagraphs}, NFPA 72 section 24.5.3 {and subparagraphs}, and NFPA 101 items 7.2.12.2.5 and 7.2.12.2.6).
- B. Related Sections
1. Comply with the Related Sections requirements of Section 270000

1.2 REFERENCES

- C. Comply with the References requirements of Section 270000.
- D. In addition, or particular to the codes and standards listed in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified.

1.3 DEFINITIONS

- E. Definitions of Section 270000 apply to this section.
- F. In addition to the Definitions article of Section 270000, the following list of terms as used in this specification defined as follows:
1. "Cabling": refer to 270000 for definition
 2. "Calling Station": System functional unit that provides two-way voice communications between the occupancy space's egress path (such as an elevator landing or area of refuge on an accessible floor) and the central control point
 3. "Central Control Point": shall mean either the a location approved by the fire department to monitor the System or fire command center
 4. "Command Station": System functional unit that that receives and controls communicates with the calling stations
 5. "IEEE": Institute of Electrical and Electronics Engineers
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6. "LED": light emitting diode
7. "Telco": shall mean the telecom utility company
8. "UPS" Uninterruptible Power Supply

1.4 SYSTEM DESCRIPTION

G. Provide planning, coordination, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working two-way communications system (herein "System") described in this section and shown on related T-series drawings.

The

System shall consist of headend equipment, command station(s), calling stations, directions (instructional signage), rough-in, cabling, programming, labeling, and connection to the designated outside phone line(s). Refer to the drawings for locations of the command station(s) and call stations.

H. System Requirements

1. The System shall fulfill the requirements and intent of CBC section 1007 (primarily 1007.8), and all subparts and references relative to two-way communications.
2. The System, including installation, shall meet applicable ADA requirements.
3. The System headend or control station shall provide power to the calling stations; the calling stations shall not require power local to station.

I. System Operation: The System shall operate as follows and/or feature the following:

1. When a call is initiated from any calling station, the System shall establish a dedicated and uninterrupted hands-free, full duplex, two-way communications session between the calling station and a command station (effectively acting as an intercom).
2. The call station shall produce a visual annunciation to indicate that a call has been placed. Annunciation may be fulfilled as an LED integrated into call station.

The

LED should illuminate as blinking when a call is placed and in queue, and

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- should
illuminate as solid when a call session has been established with the
command
station.
3. The command station shall produce visual and audible annunciations to
indicate
an incoming call from a call station. Visual annunciation may be fulfilled as
an LED
integrated into the command station or a separate strobe. Audible
annunciation
may be fulfilled as a loud ring integrated into the command station or as a
separate
siren.
4. The command station (or associated annunciation panel) shall display
requisite
information – identify the call station showing the station identifier,
story/floor/level,
and location on the given level.
5. When the command station has an active conversation with one calling
station, the
System shall automatically queue additional calls from other calling stations
and
shall automatically put through the calls in order received when the previous
call
is completed.
6. When the central control point is not staffed, the System shall automatically
route
calls from call stations to an emergency outside line. This will allow a call
placed
from a call station to ultimately reach a monitored rescue team.
7. The System shall be able to initiate a call at the command station to any
calling
station.
- J. Provide a UPS to power the System for at least 4 hours in the event of a loss of
utility or
normal power.
- K. Provide instructional signage at calling stations (directions for using calling station).
- L. Provide labeling and identification tags.

1.4 SUBMITTALS

M. Comply with Submittal procedural, quantity, and format requirements of Section 270000.

N. Substitutions: Comply with the Requests for Substitutions requirements and procedures of Section 270000.

O. Submittal Requirements Prior to the Start of Construction:

1. Product Data Submittal, consisting of production details (specifications, dimensions, connectivity requirements, etc.) and regulatory listings and certifications
2. Shop Drawings Submittal, consisting of system configuration diagrams (for example, block diagram, riser diagram, and/or other diagrams), floor plans (showing station locations), installation details, and system labeling
 - a. The shop drawings shall show the dimensioned location where the control station and System equipment will be installed.
3. Schedule Submittal, consisting of proposed schedule of work – this schedule may be combined with the schedule developed for division 27

P. Submittal Requirements at Closeout:

1. As-Built Drawings, consisting of floors plans (can be combined with telecommunications as-built drawings), block diagrams, and other drawings to accurately and fully describe the System – refer to section 270000 “Submittals” for more information
2. Warranty statement and instructions (contact information, etc.)
3. O&M Manuals, consisting of product cut sheets, as-built drawings, and warranty information– also refer to section 270000 “Submittals” for more information

1.6 QUALITY ASSURANCE

Q. Comply with quality assurance requirements of Section 270000.

1.7 DELIVERY, STORAGE, AND HANDLING

R. Comply with the delivery, storage and handling requirements of Section 270000.

1.8 WARRANTY

- S. Warrant the System as required in the general warranty.
- T. In addition, warrant the System for the manufacturer's full period – 5 years minimum.

PART 2 PRODUCTS

2.1 GENERAL

- A. Equipment shall meet requirements of CBC section 1138A.4.
- B. System electrified components (such as headend equipment, control stations, and calling stations) shall be UL listed.
- C. Communications shall be full duplex.

2.2 MANUFACTURERS

- A. RATH

2.3 DEVICES

- A. Command Station
- B. Calling station
- C. Central Equipment
- D. Indicator Panel
- E. Call Station Signage

- 1. Call station signage shall comply with CBC 1007.8.2.
- 2. Call station signage shall display the following information.
 - a. Location identification with the specific story, floor location, building address (or other building identifier), and any other information to uniquely identify the exact location – example: "Level 4 West Stair"
 - b. Directions for use of the two-way communications system
 - c. Instructions for summoning assistance via the two-way communications system

2.4 CABLE, TERMINATION APPARATUS, AND CABLE LABELS

- A. Refer to manufacturer requirements for product and code specific cable, termination and labeling.

PART 3 EXECUTION

3.1 GENERAL

- A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

- A. Call Stations: Prior to installation:

1. Confirm the installation dimensions of call stations and associated signage within each space (as the station may impact surrounding finishes).
1. Verify that the rough-in is installed properly using the proper products.
3. Verify locations are ready for the installation and that surfaces are suitable to accept the calling stations.

- B. Central Control Point: Prior to installation, verify the room is ready for the installation and that surfaces are suitable to accept the control stations and equipment.

3.3 INSTALLATION

- A. Call Stations

1. Height: Installation height of calling stations shall comply with CBC figures 11B-5C "Forward Reach" and 11B-5D "Side Reach"
2. Fasteners: Install calling stations using tamper-proof screws; quantity and type as required by the manufacturer's installation instructions.
2. Permanently install signage displaying information required by CBC.

- B. Command Stations

1. Install headend equipment into rack at the designated location, and make final connections. Dress wiring and cords within cable management apparatus.

- C. Command Station Indicator Panel

1. Install indicator panel onto the wall at the designated location. Label the command station's indicator panel with each calling station's requisite information.

D. System Programming

1. Program each calling station per the manufacturer's instructions to call directly to the command station.
2. Program each command station/headend equipment with each call station's requisite information. Program each command station/headend equipment with the automatic roll-over number (number provided by the District).

E. Cabling: Refer to section 271513 for cabling installation and labeling requirements – placement, termination, patching/cross connecting, identifier, and labeling.

F. Cabling Testing: Refer to section 270811 for cabling testing requirements.

3.4 PROTECTION

A. After installation, protect in place call stations, signage, headend equipment, command stations, and related equipment/accessories to mitigate damage from other construction activities.

B. Repair damaged call stations, signage, and related System equipment/accessories to a like-new condition. Replace products damaged beyond repair, at no cost to the District.

3.5 PRE-FUNCTIONAL TESTING

A. Test cabling per the requirements of 270811.

B. Test the emergency outside line. Ensure the line is active and successfully reaches a monitoring rescue team.

3.6 FUNCTIONAL TESTING

A. Prior to acceptance testing, perform the functional testing and submit a functional testing report.

B. Test 1: Calling Station Operation

1. At each calling station, press the call button.

2. While the call station is in the process of establishing a connection with the command station (e.g., dialing), confirm the call station illuminates the dialing-in-process

light. Record the light operation.

3. Confirm each station establishes a two-way communications link with the command station. Record each station's operation (establishing a two-way connection with the command station).
4. While the call is established between the call station and the command station, confirm the call station illuminates the call-established light. Record the light operation.

C. Test 2: Command Station Operation

1. At the command station, call each calling station to confirm the command station has the ability to dial each calling stations. Record the command station operation.

D. Test 3: Cueing Multiple Calls

1. At 2 calling stations, press the call button at one station and then the call button at the other call station.
2. Confirm the first call station establishes a connection with the command station and the other call station gets put is cue. Record the System operation.
3. At the command station, disconnect the first call station. Confirm the second call station (the one that was in cue) establishes a connection with the command station. Record the System operation.

E. Test 4: Automatic Dial Out to Emergency Line

1. At a calling station, press the call button. At the command station, do not pick up the call – let the System roll the call over to the emergency outside line (to the monitoring rescue team). Record the System operation.

3.7 FINAL INSPECTION AND ACCEPTANCE TESTING

- A. Comply with system acceptance and certification requirements of section 270000.
- B. Punch the Work of this Section compliant to the requirements of section 270000.
- C. Demonstrate System's operation witnessed by the District, IOR, architect, engineer,

general contractor, and System installer. The District will accept the System only after testing demonstrates 100% functionality of calling stations, command station(s), calling scenarios, and as accepted by the IOR. Demonstrate the following System operation:

1. Calling station operation (operation, 2-way communications with command station, visual indicators)
2. Command station operation (operation, receiving calls from calling station, station identification per call, cueing multiple concurrent calls)
3. Automatic roll over to outside line / monitored rescue team

D. Remove and replace with new, at no cost to the District, stations and/or other components failing to meet the requirements of this section until the System proves fully functional.

3.8 TRAINING

A. Provide 3 one-hour sessions with the District to train the system users. Training should cover (at least): system configuration (general arrangement of system and components), cabling (cable type, routes, cross connections), stations (detailed descriptions, features), system programming, emergency outside line (connection location, number, description of the monitoring rescue team), and other pertinent aspects.

END OF SECTION

SECTION 27 60 00 - PHYSICAL SECURITY GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE

- A. Refer to Section 27 00 00 for additional project scope information.
- B. This section describes the general product and execution requirements related to furnishing and installing Physical Security Systems. Physical Security Systems includes Video Surveillance and Electronic Access Control.
- C. Contractor shall be responsible for providing complete and functional systems as described in this specification and project drawings.
- D. Contractor shall provide low voltage power and control lines to and from power supplies, remotely controlled equipment, and other devices, even though not explicitly indicated on drawings or listed in equipment tables.
- E. Contractor coordinate with Electrical Contractor for provision of high voltage power and conduits/raceway, where necessary.
- F. Contractor shall be responsible for any and all related programming and end-user training unless noted otherwise.

1.02 RELATED WORK

- A. Section 27 00 00 – Basic Materials and Methods
- B. Section 27 10 00 – Structured Cabling System
- C. Section 28 16 00 – Access Control System
- D. Section 28 23 00 – Video Surveillance System

1.03 REFERENCE

- A. In addition to any requirements below, Contractor shall abide by requirements delineated in 27 00 00 including but not limited to:
 - 1. General: Definitions, reference standards and codes, qualifications, pre-construction submittals, construction progress submittals, closeout submittals, and correction period.
 - 2. Products: Substitutions, product specifications, miscellaneous material, cable, connectors, power devices, and interface panels.
 - 3. Execution: Coordination, testing, training, warranty, and cable management.

1.04 QUALIFICATIONS

- A. Training: Programmer shall have received manufacturer-provided and/or manufacturer approved training in the configuration of the physical security system(s) being provided.

- B. Certification: Programmer shall hold the highest applicable manufacturer programming certification(s) offered by the manufacturer(s) of the physical security system(s).
 - 1. Access Control System programmer shall have completed the Vanderbilt Technical Training Package (VTTP) for the configuration of the Vanderbilt access control system.
 - 2. Video Surveillance System contractor shall have received manufacturer-provided or approved training in the configuration of the Video Insight video management system.
- C. Submittal: Certification certificate shall be submitted with physical security system(s) submittals.

1.05 PRE-CONSTRUCTION SUBMITTALS

- A. Hardware, Application Software, and Network Requirements: A system description including analysis and calculations used in sizing equipment required by the Physical Security Systems. The description shall show how the equipment will operate as a system to meet the performance requirements of the systems. The following information shall be supplied as a minimum:
 - 1. Description of site (field) control equipment (Controllers/Field Panels) and their configuration
 - 2. Operating System(s) Software, where software is provided or upgraded
 - 3. Application Software, with Optional and Custom Software Modules supplied in this project
 - 4. Integration Schemes: Proposed connectivity, software, development requirements, and SDK information, for inter-system communication.
 - 5. Network reliability requirements.
 - 6. Number and location of LAN ports
 - 7. required Number of IP addresses
 - 8. Other specific network requirements, preferences, and constraints
 - 9. Backup/archive system size and configuration
 - 10. Access Control Power Calculations
 - 11. Start-up operations
 - 12. Battery backup requirements

1.06 CLOSEOUT SUBMITTALS

- A. Quick-Reference Guides: Contractor shall create a concise quick-reference guide covering normal system operation and basic troubleshooting procedures for each room/system type. Length of each quick-reference guide shall be commensurate with the information needed for successful operation, subject to Owner approval.
 - 1. Upon Owner approval, Contractor shall provide two (2) laminated copies and one (1) digital copy for each room/system type.

- B. Serial Numbers: Contractor shall provide a list of serial numbers for all supplied components with serial numbers and with a unit price greater than \$99. Organize list by room/system type.

PART 2 PRODUCTS

2.01 REFER TO INDIVIDUAL SECTIONS.

PART 3 EXECUTION

3.01 NETWORK TIME PROTOCOL (NTP) SYNCHRONIZATION

- A. All security systems as well as additional integrated systems such as intercom/PA, SQL/database servers and data logging servers shall synchronize to a common NTP server.
- B. All systems including servers and workstations shall be within 50ms of each other or less depending on specific system requirements such as failover. The synchronization frequency shall be no less than every 3 hours.
- C. The Contractor shall coordinate with the Owner for a NTP server connection. The Contractor shall verify the accuracy of the Owners NTP server before utilizing it.
- D. When a reliable NTP server is not available from the Owner the Contractor shall not utilize the built in Microsoft Windows NTP servers or registry tweaks shall not be utilized. The Contractor shall use software such as NetTime (www.timesynctool.com) installed on the appropriate server.
- E. Workstations on the private security network shall have an NTP client such as NetTime operating as a Windows service to sync the workstations clock to the same NTP server as the rest of the security systems.
- F. When an external internet connection is not available the Contractor shall provide a GPS based NTP server such as the Veracity Timenet or equal.

3.02 TRAINING

- A. On-Site Training
 - 1. General: Present, review and describe equipment and materials to the Owner and Owner's operating personnel and fully demonstrate the operation and maintenance of the systems, equipment and devices specified herein.
Include with new systems, Contractor to arrange and provide for video recording of each onsite training session.
 - a. Provide professional video and audio recording of each software screen option with Owner approval of content.
 - b. Provide end user video recording for Department of Safety & Security approved processes.
Provide Security Systems Specialists approved recording of maintenance and troubleshooting process.
 - 2. Provide Security Systems Specialists approved recording of maintenance and troubleshooting process.

3. Training shall comprise two separate levels of training;
 - a. User Group upon substantial completion of the project.
 - i. User group training shall include a site/building walk through indicating locations of equipment and their usage.
 - ii. User group training shall include the operation of workstation capability of system monitoring, command override and report generation.
 - b. Maintenance Group upon completion of the project prior to close out.
 - i. Maintenance group training shall include a site/building walk through indicating locations of equipment and their usage at up to six representative sites.
 - ii. Review of a-build documentation at each controller location.
 - iii. Troubleshooting techniques in hardware and software.
4. The training shall cover the overall system, each individual system, each subsystem, and each component. The training shall also cover procedures for database management, normal operations, and failure modes with response procedures for each failure. Each procedural item shall be applied to each equipment level.
 - B. Duration: Refer to the individual sections for the minimum time requirements.

3.03 WARRANTY

- A. Furnish and guarantee maintenance, repair and inspection service for the system using factory trained authorized representatives of the manufacturer of the equipment for a period of one year after final acceptance of the installation.
- B. Third Party Device warranties are transferred from the manufacturer to the Contractor, which may then transfer third party warranties to the Owner. Specific third party warranty details, terms and conditions, remedies and procedures, are either expressly stated on, or packaged with, or accompany such products. The warranty period may vary from product to product.

These products include but are not limited to devices that are directly interconnected to the field hardware or computers and are purchased directly from the manufacturer.
- C. Purpose
 1. The Contractor shall repair any system malfunction or installation deficiency discovered by the Owner or their representatives during the burn in and warranty period.
 2. The Contractor shall correct any installation deficiencies found against the contract drawings and specifications discovered by the Owner or their representatives during the warranty period.

3.04 EXAMINATION OF SITE AND DOCUMENTS

- A. Bidder shall examine all documents, shall visit the site(s) prior to submitting proposal, record their own investigations, and shall inform themselves of all conditions under which the Work is to be performed at the site(s) of the Work, including the structure of the ground, the obstacles that may be encountered, and all of the conditions of the documents, including s

uperintendence of the Work, requirements of temporary environmental controls, the time of completion, list of Subcontractors, and all other relevant matters that may affect the Work or the proposal process.

- B. Verify cable lengths comply with published standards.
- C. Notify Owner/Consultant of installation that would exceed maximum lengths prior to installation of cable.
- D. Contactor shall consult with Owner/Consultant regarding alternative routing or location of
- E. cable. Do not proceed until unsatisfactory conditions have been corrected.
- F. Failure to make the examination shall not result in any Change Order requests.
- G. The Bidder shall base the proposal on the site(s) examination, materials complying with the plans and specifications and shall list all materials where the proposal form requires.
- H. The commencement of work by the Contractor shall indicate acceptance of existing conditions, unless a written notice of exceptions has been provided to the Owner/Consultant prior to commencement.
If the Contractor observes, during preliminary examinations or subsequent work, existing
- I. violations of fire stopping, electrical wiring, grounding, or other safety- or code-related issues, the Contractor shall report these to the Owner/Consultant in a timely manner.

3.05 INSTALLATION REQUIREMENTS

- A. Contractor shall furnish and install all cables, connectors, and equipment as shown on Drawings and as specified herein.
- B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified. This includes any modifications required to route and conceal horizontal distribution wiring.
- C. Beginning installation means Contractor accepts existing conditions.
- D. Contractor shall furnish all required installation tools to facilitate cable pulling without damage to the cable jacket. Such equipment shall include, but not be limited to, sheaves, winches, cable reels, cable reel jacks, duct entrance tunnels, pulling tension gauge, and similar devices. All equipment shall be of substantial construction to allow steady progress once pulling has begun. Makeshift devices that may move or wear in a manner to pose a hazard to the cable shall not be used.
- E. All cable shall be pulled by hand unless installation conditions require mechanical assistance. Where mechanical assistance is used, care shall be taken to ensure that the maximum tensile load for the cable as defined by the manufacturer is not exceeded. This may be in the form of continuous monitoring of pulling tension, use of a "break-away," or other approved method.
- F. The Contractor shall be responsible for identifying and reporting to the General Contractor any existing damage to walls, flooring, tiles, and furnishings in the work area prior to start of work. All damage to interior spaces caused by the installation of cable, raceway, or other hardware shall be repaired by the Contractor.

- G. Repairs shall match preexisting color and finish of walls, floors, and ceilings. Any Contractor- damaged ceiling tiles, floor, and carpet shall to be replaced to match color, size, style, and texture.
- H. Where unacceptable conditions are found, the Contractor shall bring this to the attention of the construction supervisor immediately. A written resolution will follow to determine the appropriate action to be taken.
- I. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all installation work. During pulling operation, an adequate number of workers shall be present to allow cable observation at all points of duct entry and exit as well as to feed cable and operate pulling machinery.
- J. Cable pulling shall be done in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 standards. Manufacturer's recommendations shall be a part of the cable submittal. Recommended pulling tensions and pulling bending radius shall not be exceeded. Any cable bent or kinked to radius less than recommended dimension shall not be installed.
- K. All wiring shall be run "free-air," in conduit, in a secured plastic raceway or in modular furniture as designated on the Drawings. All cable shall be free of tension at both ends. PLENUM rated cable shall be used in areas used for air handling.
- L. Avoid abrasion and other damage to cables during installation.
- M. Pulling lubricant may be used to ease pulling tensions. Lubricant shall be of a type that is non- injurious to the cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.
- N. The cable system will be tested and documented upon completion of the installation as defined in the section below.
- O. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit or surface mount raceway. Should it be found by the Consultant that the materials or any portion thereof furnished and installed under this contract fail to comply with the specifications and Drawings with the respect or regard to the quality, amount of value of materials, appliances, or labor used in the work, it shall be rejected, removed, and replaced by the Contractor and all work distributed by changes necessitated in consequence of said defects or imperfections shall be corrected at the Contractor's expense.
- P. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by manufacturers or as indicated in their published literature, unless specifically noted herein to the contrary.

3.06 COOPERATION

- A. The Contractor shall cooperate with Consultant's and Owner's personnel in locating work in a proper manner.
- B. Should it be necessary to raise, lower, or move longitudinally any part of the work to better fit the general installation, such work shall be done at no extra cost to the Owner, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.

3.07 COMMISSIONING SUBMITTALS

- A. Provide the following to the Owner no later than 30 days prior to system commissioning/programming.
 - 1. Commissioning Test Plan and Check-Off List: Specified elsewhere in this
 - 2. document. Web-based Training: Access to web-based training modules.

3.08 COMMISSIONING

- A. Provide programming and commissioning for each system as described in individual sections below.
- B. This Contractor shall develop and submit a plan for coordination of settings and programming issues with the Consultant and Owner no later than 30 days prior to performing programming and commissioning.
- C. The security Contractor is required to place entire system into full and proper operation as designed and specified.
- D. Verify that all hardware components are properly installed, connected, communicating, and operating correctly.
- E. Verify that all system software is installed, configured, and complies with specified functional requirements.
- F. Perform final acceptance testing in the presence of Owner's representative, executing a point-by-point inspection against a documented test plan that demonstrates compliance with system requirements as designed and specified.
 - 1. Submit documented test plan to Owner at least 14 days in advance of acceptance test, inspection, and check-off.
 - 2. Conduct final acceptance tests in presence of Owner's representative, verifying that each device point and sequence is operating correctly and properly reporting back to control panel and control center.
 - 3. Acceptance by Owner is contingent on successful completion of check-off; if check-off is not completed due to additional work required, re-schedule and perform complete check-off until complete in one pass, unless portions of system can be verified as not adversely affected by additional work.
 - 4. The system shall not be considered accepted until all acceptance test items have been successfully checked-off. Beneficial use of part or all of the system shall not be considered as acceptance.

3.09 OPERATION AND MAINTENANCE MANUALS

- A. Part One: Notwithstanding requirements specified elsewhere, submit the following labeled as the "Operating and Maintenance Manual" within thirty (30) days after Final Acceptance of the Installation:
 - 1. Record Drawings: Submit two (2) copies of revised versions of drawings as submitted in the "Shop and Field" and "Equipment Wiring Diagrams" Submittals showing actual device locations, conduit routing, wiring and relationships as they were constructed. I

- include nomenclature showing as-built wire designations and colors. Drawings shall include room numbers coinciding with Owner space planning numbering. Drawings shall be submitted in electronic editable AutoCAD 2018 files, in “.dwg” format and Adobe Portable Document Format “.pdf” on USB flash drives.
2. Manuals: Submit one (1) copy of each of the following materials in an electronic PDF, with labeled dividers:
 - A final Bill of Material for each system
 - a. Equipment Instruction Manuals: Complete, project specific comprehensive instructions for the operation of devices and equipment provided as part of this work.
 - b. Manufacturers Instruction Manuals: Specification sheets, brochures, Operation Manuals and service sheets published by the manufacturers of the components, devices and equipment provided.
 - c. Include information for testing, repair, troubleshooting, assembly, disassembly and recommended maintenance intervals.
 - d. Provide a replacement parts list with current prices. Include list of recommended spare parts, tools, and instruments for testing and maintenance purpose.
 - e. Performance, Test and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified herein.
 - f. Warranties: Provide an executed copy of the Warranty Agreement and copies of all manufacturer’s Warranty Registration papers as described herein.
 - B. Part Two: Within fourteen (14) days of receipt of Consultant reviewed Operating and Maintenance Manual (Phase One), submit three (3) electronic copies in AutoCAD 2018 editable .dwg format of the reviewed Record Drawings and three (3) copies of the reviewed Operating and Maintenance Manuals in Adobe Portable Document Format “.pdf” to the Owner, on USB flash drives.
 1. Within each equipment enclosure and/or terminal cabinet, the Contractor shall place a Single Line drawing of the system(s) and the respective Terminal Cabinet Wiring Diagram in a clear plastic sleeve permanently attached to the inside cover of the terminal cabinet.
 2. In each equipment enclosure the Contractor shall place a drawing providing device locations served by the equipment within the enclosure with identification that is identical to the wiring tags and with the software description of each point.
 3. The Contractor shall provide to the Owner one (1) copy of new administration and user software, including required graphical maps, on USB flash drives.
 - C. Sufficient information, (detailed schematics of subsystems, assemblies and subassemblies to component level) clearly presented, shall be included to determine compliance with drawings and specifications.

3.10 CLOSEOUT PROCEDURES

- A. Notification: Contractor shall provide written notification to Architect/Consultant and Owner when Contractor is satisfied that the work has been completed and is ready for inspection.

- B. Closeout Submittals: Contractor shall provide closeout documentation to the Architect/Consultant. The Architect/Consultant shall receive the closeout submittals no less than 72 hours prior to the scheduled inspection time.
- C. Inspection: Contractor shall be present for the inspection by the Architect/Consultant. Contractor shall supply all testing equipment needed to verify compliance with the specifications found in Bid package.
- D. Punch List: Work or materials found to be incomplete, of unsatisfactory quality, failing to meet the specifications in the Bid package, and/or unacceptable to the Architect/Consultant shall be documented by the Architect/Consultant and provided to Contractor to rectify.
Re-Inspection: If a re-inspection is necessary, the costs of the Architect/Consultant's additional travel, hours, and expenses may be deducted by the Owner from the contract amount due Contractor.
- E.
- F. Punch List Approval: The punch list shall be considered complete only after having been signed by the Owner and Architect/Consultant.
- G. The system has successfully completed a 30-day performance period.
- H. Payment Authorization: Final payment will be authorized only after all closeout procedures and requirements have been followed and fulfilled by Contractor and approved in writing by the Owner and Architect/Consultant, including punch list(s) and/or re-inspection(s).
- I. Response Time: Response time for service calls.
 - 1. Emergency service calls where system is not responding to staff directed commands through the computer systems shall be within 2 hours to the project site.
 - 2. Emergency service calls where controllers are not reporting shall be within 2 hours to the project site.
 - 3. Normal service calls for device malfunctions shall be within 24 hours during normal working hours to the site.
- J. Repair Time: Contractor shall stock parts in sufficient quantities such that repair or replacement shall be guaranteed within 12-hours. Temporary replacements within this time period shall be acceptable, provided temporary replacements do not compromise system functionality, and provided permanent replacement is achieved within 72 hours. Contractor may contact Owner representative for use of Owner supplied spare parts where delay of system repair will have negative impact on system performance.
- K. Commencement: The warranty begins at the time of issuance of the statement of "Final Acceptance of the Installation" by the Owner.
Transferability: The warranty shall be transferable to any person or persons at the discretion of the Owner.
- L.
- M. Transmittal: A copy of this Warranty shall be delivered to, and signed for by the Owner's representative whose primary responsibility is the operation and care of these systems. A copy of the signed Warranty document shall be delivered for review as part of the Final Submittals.

- N. Registration: Register Warranty papers for all equipment and software in the name of the Owner. Furnish reproductions of all equipment Warranty papers to the Owner with the Final Submittals.
- O. Subcontracting: Warranty service work may not be subcontracted except with specific permission and approval by the Owner.
- P. Resolution of Conflicts
 - 1. The Owner retains the right to resolve unsatisfactory warranty service performance at any time by declaring the work unsatisfactory, stating specific areas of dissatisfaction in writing.
 - 2. If the Contractor or his approved Subcontractor does not resolve such stated areas of dissatisfaction within thirty (30) days, the Owner may appoint any alternative service agency or person to fulfill the terms of the Warranty; the cost of which shall be borne by the Contractor. This action may be taken repeatedly until the Owner is satisfied that Warranty service performance is satisfactory. Satisfactory resolution of a malfunction shall be considered adequate when the device, equipment, system or component which is chronically malfunctioning is brought into compliance with the standards of performance as contained herein and published by the manufacturers of the equipment installed.

END OF SECTION

SECTION 28 05 00 - GENERAL ELECTRONIC SAFETY SYSTEMS REQUIREMENTS

PART 1 – GENERAL

1.1 WORK INCLUDES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, apply to this Section.
- B. Furnishing of all required materials, equipment, tools, scaffolding, labor, and transportation necessary for the complete installation of the Electronic Safety Systems as shown on the drawings and as specified herein.
- C. Coordinate wireway, raceway, power, and outlet requirements with the builder and the electrical contractor.
- D. Cable pathways, conduit, boxes and cable support systems shall be complete with bushings, de-burred, cleaned, and secure prior to installation of cable.
- E. The Electronic Safety Systems Contractor shall provide and install prior to cable installation plastic snap in bushings at each box opening, passage through a metal stud, and at the end of all open conduit stubs or sleeves to protect the cabling from damage.
- F. Supply in a timely manner to the electrical contractor special backboxes for installation as required.
- G. It is the intent of the Contract Documents to provide complete installations although every item necessary may not be specifically mentioned or shown.
- H. It is the intent of the Contract Documents to provide an extension of the existing installed systems interfaced with new systems, complete in every respect.
- I. Provide line-by-line specification review for each Division 28 section annotated to certify compliance or deviation.

1.2 WORK TO BE INCLUDED BY THE ELECTRICAL CONTRACTOR IN BASE CONTRACT PROPOSAL

- A. Provide utility services conduit as outlined on drawings as required.
- B. All required conduit for accessibility to attic space.
- C. Furnishing and installation of all required standard back boxes and conduit.
- D. Installation of special back boxes supplied by Division 28 contractor(s).
- E. Furnishing and installation of all floor boxes, surface raceways, and other wireways which are detailed or specified under Division 26.
- F. Provide equipment-mounting boards as outlined on drawings.
- G. Provide equipment grounding system, conductors, and bus bars and as outlined in Division 26.

- H. Provide 120-volt power and hook-up to equipment provided in Division 28.
- I. Coordination of requirements of Division 28 with the Builder.

1.3 WORK NOT INCLUDED

- A. Contractors shall make no agreement that obligates the Owner to pay any company providing communications, monitoring, or other services. Contractors shall not make selection, purchase, or installation of interconnect instruments/equipment to be used on this project.

1.4 RELATED SECTIONS

- A. The conditions of the Division 0, Division 1, Division 26 requirements, and the contract requirements that include the General Conditions and the Supplementary Conditions apply to work of this division.
- B. Section 26 05 34 - Provisions For Communication, Security & Safety Systems.

1.5 CODES, STANDARDS, AND THEIR ABBREVIATIONS

- A. General:
 - 1. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.
 - 2. In addition to the requirements outlined in other sections of the specifications the following standards are imposed as applicable to the work in each instance:
 - a. OSHA Safety and Health Regulations for Construction.
 - b. NFPA No. 70 National Electrical Code.
 - c. NESC National Electrical Safety Code, ANSI Standard C2.
 - d. NEiS National Electrical Installation Standards.
 - e. Local Codes and Ordinances.
- B. Where local codes or practices exceed or conflict with the NEC, it shall be the Contractor's responsibility to perform the work in accordance with the local code prevailing and local interpretations thereof. Any such additional work shall be performed at no additional cost to the Owner.
- C. Materials and components shall be UL listed and labeled by Underwriters Laboratories, Inc. for the intended use under the latest appropriate testing standard.
- D. The Contractor shall obtain all permits required to commence work. Upon completion of the Work, the Contractor shall obtain and deliver to the Owner's Representative a Certificate of Inspection and Approval from the State Board of Fire Underwriters, the City of Little Elm, Texas, and other authorities having jurisdiction. The Contractor shall pay required permit fees.

1.6 LIST OF ASSOCIATIONS AND STANDARDS:

ADA:	Americans with Disabilities Act.
ANSI:	American National Standards Institute, 1430 Broadway; New York, NY 10018.
ASTM:	American Society for Testing and Materials, 1916 Race Street; Philadelphia, PA 19103.
BICSI:	(RCDD5 Standards), 8610 Hidden River Parkway, Tampa, FL 33637
CBM:	Certified Ballast Manufacturers Association, 2116 Keith Building; Cleveland, Ohio 44115.
IEEE:	Institute of Electrical and Electronics Engineers, 345 East 47th Street; New

York, NY 10017.
ICEA: Insulated Cable Engineers Association, P.O. Box P, South Yarmouth, MA 02664.
NEC: National Electrical Code; NFPA No. 70.
NECA: National Electrical Contractors Association, Inc., 7315 Wisconsin Ave.; Washington, DC 20014.
NEMA: National Electrical Manufacturers Association, 155 East 44th Street; New York, NY 10017.
NESC: National Electrical Safety Code, ANSI Standard C2.
NFPA: National Fire Protection Association, 60 Batterymarch Street; Boston, MA 02110.
OSHA: Occupational Safety and Health Administration, US Department of Labor; Washington, DC 20402.
TAS: Texas Accessibility Standards (TAS) Article 9102.
UL: Underwriters Laboratories, Inc., 333 Pfigsten Road; Northbrook, IL 60062.

- A. Nothing in the Contract Documents shall be construed to permit work not conforming to these codes.
- B. When two or more codes or standards are applicable to the same work, then the stricter code or standard shall govern.
- C. The date of the code or standard is that in effect on the date of issue stated on the contract documents, except when a particular publication date is specified.
- D. The Contractor shall comply with all State, Federal, NFPA, local codes and ordinances that may alter any part of the plans or specifications. The Contractor shall bear all costs for correcting any deficiencies due to non-compliance.
- E. Where local codes and ordinances are not in writing or on record but local precedence have been set, the Owner shall pay for any additional resulting cost.

1.7 DEFINITIONS

- A. Approval: It is understood that approval must be obtained from the Architect in writing before proceeding with the proposed work. Approval by the Architect of any changes, submitted by the Contractor, will be considered as general only to aid the Contractor in expediting his work.
- B. The Builder: The primary contractor engaged to oversee the construction project. They may be technically described as a Construction Manager, General Contractor, Managing Construction Contractor, et cetera.
- C. The Contractor: The Contractor engaged to execute the work included a particular section only, although he may be technically described as a Subcontractor to the Builder. If the Contractor, engaged to execute said work, employs Sub-Contractors to perform various portions of the work included under a particular Section, they shall be held responsible for the execution of this work, in full conformity with Contract Document requirements. The Contractor shall cooperate at all times and shall be responsible for the satisfactory cooperation of his Subcontractors with the other Contractors on the job so that all of the various sections and phases of work may be properly coordinated without unnecessary delays or damage.
- D. The Electrical Contractor: The Electrical Contractor shall be engaged to execute the work included Division 26 only.
- E. PDF file or .pdf: The filename extension associated with "Portable Document Format" files, which are multi-platform computer files in the ISO 32000-1:2008 open standard format

developed and licensed by Adobe Systems. These files are a digital electronic representation of text, documents, images, and technical drawings in a font and color-accurate fixed-layout format that is platform and display resolution independent. PDF files can be electronically transmitted, viewed, or printed with various free PDF reader application programs, and may allow markups/comments with various PDF editing application programs.

- F. Provide: Defined as requiring both the furnishing and installation of the item or facility indicated, complete in all respects and ready for operation unless otherwise specifically noted.

1.8 SCHEDULE OF VALUES, APPLICATION FOR PAYMENT

- A. The Contractor shall in accordance with the General Provisions of the Contract, including General and Supplementary Conditions, and Division 1, complete a Schedule of Values and Applications for Payment. When a portion of this work separately funded, including donations or E-Rate, the contractor shall accommodate this in the Schedule of Values and Applications for Payment. For E-Rate eligible portions of this work, the contractor will be required to participate in the E-Rate program, comply with all E-Rate regulations, and provide billing as needed. The contractor shall coordinate with the Owner to file Form 471 or latter edition and/or other forms as may be required.

1.9 WARRANTY

- A. The Contractor shall warranty his work against defective materials and workmanship for a period of one year from date of acceptance of the job.
- B. Neither the final payment nor any provisions in Contract Documents shall relieve the Contractor of the responsibility for faulty materials or workmanship.
- C. He shall remedy any defects due thereto, and pay for any damage to other work resulting there from, which shall appear within a period of one year from date of substantial completion.
- D. The Owner shall give notice of observed defects with reasonable promptness.
- E. This Warranty shall not be construed to include the normal maintenance of the various components of the system covered by these specifications.

1.10 SITE VISIT

- A. Before submitting a proposal, each proposed contractor shall examine all plans and specifications relating to the work, shall visit the site of the project, and become fully informed of the extent and character of the work required, including all required utilities.
- B. No consideration will be granted for any alleged misunderstanding of the materials to be furnished or the amount of work to be done, it being fully understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying plans or required by nature of the site of which may be fairly implied as essential to the execution and completion of any and all parts of the work.

1.11 SUBMITTALS

- A. Submittal procedures shall be per Division 1 - General Requirements.
- B. Provide a complete submittal for each section as specified.
- C. Submit complete submittal package within 30 calendar days after award of this work for approval. Equipment is not to be ordered without approval. Partial submittals are not

acceptable for review. Each submittal shall include a dated transmittal.

- D. A submittal may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- E. Each Product data submittal shall include:
 - 1. A cover sheet with the name and location of the project, the name, address, and telephone number of the Contractor, and the name, address, and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
 - 2. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 - 3. A product data index and complete equipment list including for each product submitted for approval the manufactures name and part number, including options and selections.
 - 4. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted.
 - 5. Submit design data, when the scope of work requires, including calculations, schematics, risers, sequences, or other data.
 - 6. When the contract requires extended product warranties, submit a sample of warranty language.
 - 7. Any resubmittal shall include a complete revised equipment list and any product data that is revised.
- F. Submit shop or coordination drawings, when specified or the required for the scope of work, which include information that will allow to the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product. Shop or coordination drawings shall be specifically prepared to illustrate the submitted portion of work, this may require diagrams, schedules, details, and accurate to scale equipment and device layouts prepared using a CAD or BIM engineering drawing program.
- G. The Engineer's review of submittals is only for confirmation of adherence to design of project and does not relieve the Contractor of final responsibility for furnishing all materials required for a complete working system and in complying with the Contract Documents in all respects.

1.12 PROJECT RECORD DOCUMENTS

- A. The Contractor shall keep a set of plans on the job, noting daily all changes made in connection with the final installation including exact dimensioned locations of all new and uncovered existing utility piping outside the building.
- B. Upon submitting his request for final payment, he shall turn over to the Architect/Engineer, for subsequent transmittal to the Owner revised plans showing "as installed" work.
- C. In addition to the above, the Contractor shall accumulate during the jobs progress the following data in PDF file format (preferred) or paper copies to be turned over to the Architect/Engineer for checking and subsequent delivery to the Owner:
 - 1. All warranties, guarantees, and manufacturer's directions on equipment and material covered by the Contract.
 - 2. PDF file or paper copies of all Shop Drawing prints and CAD or BIM engineering drawing program files.
 - 3. Any software programs, data/programming files, passwords, special interface cables, or

- keys that may be needed to maintain or access equipment.
4. Set of operating instructions. Operating instructions shall also include recommended maintenance and seasonal changeover procedures.
 5. Any and all other data and/or plans required during construction.
 6. Repair parts lists of all major items and equipment including name, address, and telephone number of local supplier or agent.
 7. The first page, or pages, shall have the names, addresses, and telephone numbers of the following:
 - a. Builder and all Contractors.
 - b. Major Equipment Suppliers
 - c. Submit communication systems warranties.

1.13 TRAINING

- A. Upon completion of the work and at a time designated by the Architect, provide formal training sessions for the Owner's operating personnel to include location, operation, and maintenance of all Electronic Safety Systems equipment and systems.
- B. See other sections for time requirements.

1.14 PLANS AND SPECIFICATIONS

- A. The intent of the project drawings is to establish the types of systems and functions, but not to set forth each item essential to the functioning of the system.
- B. Electrical drawings are generally diagrammatic and show approximate location and extent of work.
- C. Install the work complete including minor details necessary to perform the function indicated. Provide Electronic Safety Systems (including all hook-ups) complete in every respect and ready to operate.
- D. If clarification is needed, consult the Architect/Engineer.
- E. Review pertinent drawings and adjust the work to conditions shown. Where discrepancies occur between drawings, specifications, and actual field conditions, immediately notify the Architect/Engineer for his interpretation.
- F. The Architect/Engineer reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.

1.15 PRODUCT SUBSTITUTIONS:

- A. Descriptions and details, acceptable manufacturers' names listed, and specific manufacturer and model number items indicated in the plans and specifications shall establish a standard of quality, function, and design. Manufacturers and model numbers listed "no exceptions" shall not be substituted without specific notice in an addendum. Otherwise, where a specific manufacturer's product is indicated, products of other manufacturers listed as acceptable may be submitted for approval based on the substitute product being, in the opinion of the Engineer, of equivalent or better quality than that of the product specified.
- B. Proposed contractors wishing to propose systems which differ in manufacturer, features, functions, or operating characteristics from those outlined in these specifications must do so in writing to the specifying authority at least ten (10) days prior to the proposal opening.

- C. For manufacturers equipment or models other than that specified, the proposed contractor shall supply proof that such substitute equipment equals or exceeds the features, functions, performance, and quality of the specified equipment. Proposals must include detailed information showing all deviations from the system as specified and include relevant technical and cost data. This shall include a complete description of the proposed substitution, drawings, catalog cuts, performance data, test data, or any other data or information necessary for evaluation.
- D. The Engineer will consider all such submittals and the Architect will issue an addendum listing items that the Engineer considers acceptable. Only such items as specified or approved as acceptable will be installed on this project.
- E. Substitute products for which the proposed contractor does not obtain prior approval will not be considered acceptable for this project. Final approval of the alternate system shall be based on the decision of the Owner and Architect. Prior approval to make a proposal for this project does not automatically ensure the system will be an acceptable equivalent.
- F. The Contractors' proposal represents that the contract proposal price is based solely upon the materials, equipment, and labor described in the Contract Proposal Documents (including addenda, if any) and that he contemplates no substitutions or extras.
- G. The manufacturer of the proposed substitute unit shall provide samples for evaluation, when required, at no charge and non-returnable.
- H. Requests for substitution are understood to mean that the Contractor:
 - 1. Has personally investigated the proposed substitution and determined that it is equivalent or superior in all respects to that specified.
 - 2. Will provide the same guarantee for the substitution that he would for that specified.
 - 3. Will, at no cost to the Owner, replace the substitute item with the specified product if the substitute item fails to perform satisfactorily.
 - 4. After Award of the Contract, substitutions will be considered only under one or more of the following circumstances:
 - a. The substitution is required for compliance with subsequent interpretations of code or insurance requirements.
 - b. The specified product is unavailable through no fault of the Contractor.
 - c. The manufacturer refuses to warranty the specified products as required.
 - d. Subsequent information indicates that the specified product is unable to perform properly or to fit in the designated space.
 - e. In the Engineer's sole judgment, the substitution would be in the Owner's best interest.
 - f. Revisions to the electrical system caused by substitutions shall be under the supervision of the Engineer, at a standard hourly rate charged by the Engineer. Charges from the Engineer, Architect, and Electrical Contractor shall be paid by the Contractor originating the changes.

1.16 FUTURE USE CABLING

- A. When cabling is installed for future use, it shall be identified with a tag of sufficient durability to withstand the environment involved.
- B. Locations and Existing Conditions:
 - 1. Location and condition of any existing equipment or services, when shown, have been obtained from substantially reliable sources, are shown as a general guide only, without guarantees as to accuracy.
 - 2. The Contractor will examine the site, verify all requirements, service points, and

availability of all services required to complete this project. No consideration will be granted for any alleged misunderstanding of the materials and labor to be provided as necessitated by nature of the site including those items that may be fairly implied as essential to the execution and completion of any and all parts of this project.

1.17 PROTECTION OF EQUIPMENT AND MATERIALS

- A. The Contractor shall take such precautions as may be necessary to protect his apparatus from damage.
- B. This shall include the creation of all required temporary shelters to protect any apparatus above the floor of the construction and the covering of apparatus in the completed building with tarpaulins or other protective covering.
- C. Failure to comply with the above to the satisfaction of the Owner's inspector will be sufficient cause for the rejection of the equipment in question and its complete replacement by the Contractor.

1.18 FINAL OBSERVATION

- A. It shall be the duty of the Contractor to make a careful observation trip of the entire project, assuring themselves that the work on the project is ready for final acceptance before calling upon the Architect/Engineer to make a final observation.
- B. To avoid delay of final acceptance of the work, the Contractor shall have all necessary bonds, warranties, receipts, affidavits, et cetera, called for in the various articles of these specifications, prepared and signed in advance, together with a letter of transmittal, listing each paper included, and shall deliver the same to the Architect/Engineer at or before the time of said final observation. The Contractor is cautioned to check over each bond, receipt, et cetera, before preparing for submission to verify that the terms check with the requirements of the specifications.
- C. The following and other provision of Division 1 General Conditions will be required at time of final completion:
 - 1. Final clean up completed.
 - 2. All systems are fully operational, all material and devices installed.
 - 3. As built (as installed) drawings and operations manuals.

1.19 PROHIBITED MATERIALS

- A. No new asbestos, lead, or materials containing these substances shall be permitted in this project. The Contractor shall consult the Architect concerning these materials if their presence is suspected. All work in or around existing asbestos or lead materials is at the sole risk of the Contractor and his personnel.

1.20 CUTTING AND PATCHING

- A. Notify the Builder sufficiently ahead of construction of any floors, walls, ceiling, roof, et cetera, of any openings that will be required for his work.
- B. The Contractor shall see that all sleeves required for his work are set at proper times to avoid delay of the job.
- C. All necessary cutting of walls, floors, partitions, ceilings, et cetera, as required for the proper installation of the work under this Contract shall be done at the Subcontractor or at the

Subcontractor's expense in a neat and workmanlike manner, and as approved by the Architect/Engineer.

- D. Patching of openings and/or alterations shall be provided by the Electronic Safety Systems Subcontractor or at the Subcontractor's expense in an approved manner.
- E. No joists, beams, girders, or columns shall be cut by any Contractor without first obtaining written permission of the Architect/Engineer.
- F. All openings in firewalls and floors shall be completely sealed after installation for a completely airtight installation. Sealing material shall be non-combustible and UL approved. The installed sealing assembly shall not cause the fire rating of the penetrated structure to be decreased.
- G. All openings in exterior walls shall be sealed watertight.
- H. Seal voids around conduits penetrating fire-rated assemblies and partitions using fire stopping materials and methods in accordance with NFPA and local codes.

1.21 MANUFACTURERS' INSTRUCTIONS

- A. All equipment and devices shall be installed in accordance with the drawings and specifications, manufacturer's instructions, and applicable codes.
- B. Where specifications call for installation of a product to be in accordance with manufacturer's instructions and/or where manufacturer's instructions are required for installation of a product, it shall be the contractor's responsibility to obtain the necessary applicable manufacturer's instructions and install the product in accordance with the manufacturer's instructions.
- C. It shall be the Contractor's responsibility to install all equipment, materials, and devices shown on the plans and as called out in these specifications even if manufacturer's instructions are absolutely unattainable.

1.22 INSTALLATION

- A. Cooperation with trades of adjacent, related or affected materials or operations, and or trades performing continuations of this work under subsequent contracts are considered a part of this work. In order to effect timely and accurate placing of work and to bring together, in the proper and correct sequence, the work of such trades, including work provided under a Division 1 allowance.
- B. The Electronic Safety Contractor shall coordinate installation of the systems with the Builder, Electrical, Mechanical, and Plumbing Contractors to ensure a complete working system for the Owner.
- C. Where required for accessibility all conduit and boxes for all Electronic Safety Systems shall be provided by the Electrical contractor as specified, including systems in Division 28, any and all allowances shall be included. Normally low voltage wiring shall run open and supported in accessible attic space. All low voltage wiring in exposed areas such as gyms, stages, shops, and field houses shall be enclosed in conduit. Coordinate with, and verify with Division 26 to provide required conduit and boxes at locations and heights as required.
- D. Conduit, innerduct, track, or raceway shall conceal and protect wiring in exposed areas, within walls, through in-accessible areas, floors, chases, under slab, crawlspaces, or underground.
- E. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such

as the installation of couplings, without disturbing adjacent pathways.

- F. All work must be performed by workers skilled in their trade. The installation must be complete whether the work is concealed or exposed.
- G. Provide stainless screw/bolt hardware wherever stainless devices are used and in potentially wet areas.
- H. Coordinate the actual locations of devices and outlets and equipment with building features and mechanical equipment as indicated on architectural, structural, and mechanical drawings. Review with the Architect any proposed changes in outlet or equipment location. Relocation of devices, before installation, of up to 3 feet from the position indicated, may be directed without additional cost. Remove and relocate outlets placed in an unsuitable location when so requested by the Architect.

1.23 ADDITIONAL MATERIALS: INCLUDE IN THE BASE CONTRACT PROPOSAL

- A. All costs to provide 10 additional fire alarm signals including all cable and devices as directed by the Architect. Conduit and standard back boxes by Division 26 Electrical Contractor.

PART 2 – PRODUCTS

- A. Not Applicable

PART 3 – EXECUTION

- A. Not Applicable

END OF SECTION

SECTION 28 05 44 – EMERGENCY RESPONDER RADIO ANTENNA SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. Design, furnish, install, and test a complete and operating in-building Emergency Responder Radio Antenna System/Distributed Antenna System ['system' or 'DAS'] to provide complete coverage for the public safety agencies as required by the local fire department, other agencies and the authority having jurisdiction [AHJ]. The system will support only Emergency Responder and Public Safety Land Mobile Radios ['LMR']. The system shall not support District Radio, Cellular, and/or Wi-Fi Signals.

1.2 WORK INCLUDES

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 apply to this Section.
- B. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of a complete Emergency Responder Radio Antenna System. The purpose is to extend and amplify the Emergency Responder and Public Safety Land Mobile Radio signals to a strength of 95% in all areas of the facility including elevators, stairwells, and all floors.
- C. It shall be the responsibility of the Emergency Responder Radio Antenna System contractor to obtain all required permits, approvals and certifications from the authorities having jurisdiction.
- D. All fees associated with the licensing shall be paid by the Contractor.
- E. Testing of the system shall conform to the testing requirements as described in the International Fire Code [IFC] Section 510.5.3.
- F. All testing must be done on frequencies authorized by the FCC and in use by local agencies as directed by the Authority Having Jurisdiction [AHJ].
- G. Final acceptance and approval shall be required from the local AHJ.
- H. It shall be the responsibility of the Electrical Contractor to provide and install all conduit systems, standard electrical boxes, and operating power for the building access systems as outlined on the project drawings. This Contractor shall coordinate all system requirements with and provide special back boxes to the Electrical Contractor prior to installation of conduit. The BDA head end shall be hardwired to electrical power and on emergency power where possible.
- I. The Electrical Contractor shall provide 120-volt power as required through separate dedicated branch circuits, maximum 20 amperes each. Each such circuit shall be labeled at the power distribution panel as EMERGENCY RESPONDER RADIO SYSTEM. The location of all circuit breakers serving the Emergency Responder Radio Coverage System shall be posted in the control unit cabinets. Each cabinet and all surge protection devices shall be grounded securely to the building grounding system.
- J. Provide all testing, documentation, training, and warranty service contract as outlined in these

FIRST RESPONDER ANTENNA SYSTEM

- specifications.
- K. Section shall include:
1. Bi-Directional Amplifiers [BDA's]
 2. Distributed Antenna System
 3. Coaxial Cables
 4. Splitters and Directional Couplers
 5. Battery Back-Up System
 6. All other equipment and components necessary for a complete and functioning Emergency Responder Radio Antenna System.
- L. Specification Compliance: A letter shall be provided stating, by section and subsection, that the intercom system installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.

1.3 SYSTEM PRICING, PHASING AND AWARD

- A. Proposed Contractor shall provide a proposal based on separate pricing for each of the following steps:
1. Outdoor Testing of the Facility – This price shall include verifying the outdoor signal strength at the facility's location.
 2. Full Testing, in accordance with IFC Section 510 Grid Testing – This price shall include verification of signal strength throughout the entire facility.
 3. Emergency Responder Radio Antenna System Materials and Installation Pricing – This price shall include a full system design and installation, including costs for design, components, materials, labor, and testing. This price shall be a "Worst-Case Scenario" situation, as though the entire facility must require coverage.
- B. The project must be budgeted as a complete set of processes, thus the reason for having all pricing, in a "Worst-Case Scenario" prior to performing any work. This pricing will provide a budget before the work begins.
- C. The award of this work will be made in phases, in accordance with the three (3) afore mentioned steps.
1. Phase I award authorizes step #1. Once step one is completed, results are to be provided to the General Contractor, Architect, and Engineer for review. Following this review, step two may be delayed, pending adjustment to the donor signal. If donor signal strength at the facility does not meet IFC Section 510 requirements, the AHJ must be consulted, prior to moving to step two. If the donor signal strength is adequate to meet IFC Section 510 requirements, authorization for step two will be given.
 2. The Phase II award authorizes step #2. Testing of the facility to determine signal strength status and to provide a base for a full system design. After testing, a final revised proposal for a full system design, installation and final testing shall be issued to the General Contractor for review. No further work is authorized until award of Phase III is granted.
 3. Phase III award authorizes step #3. Design, installation, and final testing of the Emergency Responder Radio Antenna System. Provide design and final acceptance testing documents per Section 1.8.

1.4 MANUFACTURERS

- A. Subject to compliance with requirements, available integrators offering products that may be incorporated in the work include, but are not limited to:
 - 1. CommScope
 - 2. Farenhyt
 - 3. Axell Wireless
 - 4. Tessco
 - 5. Times Microwave
 - 6. Gamewell-FCI
 - 7. Notifier
 - 8. SOLiD Technologies – Alliance Corporation
 - 9. Simplex
 - 10. Other manufacturers upon approval.

1.5 RELATED SECTIONS

- A. Section 26 05 34 - Provisions for Communication, Security & Safety Systems.
- B. Section 28 05 00 - General Electronic Safety and Security System Requirements.
- C. Section 28 46 21 – Fire Detection and Alarm System

1.6 CODES AND REGULATIONS

- A. Perform all work in strict accordance with the requirements and recommendations stated in the codes and standards except when requirements are exceeded by the contract documents.
- B. The equipment, materials, and installation shall conform to the latest version of all applicable codes, standards and regulations of authorities having jurisdiction including the following:
 - 1. NFPA 1 – The National Fire Code (including Annex O from 2009)
 - 2. NFPA 70 – The National Electrical Code
 - 3. NFPA 72 – National Fire Alarm Code
 - 4. NFPA 1221 – Standard for the Installation, Maintenance and Use of Emergency Services Communication Systems
 - 5. UL 2524 - 1st Edition In-building 2-Way Emergency Radio Communication Enhancement Systems
 - 6. FCC 47 CFR Private Land Mobile Radio
 - 7. FCC 47 90.219-2007 Services-Use of Signal Boosters
 - 8. ICC 2009 International Fire Code, Code and Commentary
 - 9. ADA “Americans with Disabilities Act”
 - 10. FCC’s OET 65 Standards “Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields”
 - 11. FCC Rules Part 22, Part 90, and Part 101

1.7 DEFINITIONS

- A. Attenuation: The reduction in signal power, expressed in decibels, as a result of coupling, heat loss, or transmission distance in a cable or in air.
- B. Bi-Directional Amplifier [BDA]: A device used to amplify band-selective or multi-band RF signals in the uplink, to the base station for enhanced signals and improved coverage. Also known as a signal booster.
- C. Coupled Bonding Conductor [CBC]: a bonding conductor placed on the outside of any technology cable. Used to suppress transient noise.

- D. Delivered Audio Quality Definitions [DAQ]: The universal standard often cited in system design, specifications, and testing reports for ERRC and DAS.
 - 1. DAQ 1: Unusable, speech present but not intelligible.
 - 2. DAQ 2: Understandable with considerable effort. Frequent repetition required due to noise and/or distortion.
 - 3. DAQ 3: Speech understandable with slight effort. Occasional repetition required due to noise and/or distortion.
 - 4. DAQ 3.5: Speech understandable with repetition only rarely required. Some noise and/or distortion
 - 5. DAQ 4: Speech easily understood. Occasional noise and/or distortion.
 - 6. DAQ 4.5: Speech easily understood. Infrequent noise and/or distortion.
 - 7. Speech easily understood.
- E. Distributed Antenna System [DAS]: A network of service antennas connected at intervals along shielded coaxial transmission lines and all connected to head-end electronics amplifying the signals to be distributed. Often refers to a system that includes both the passive distribution system and the active amplifying electronics.
- F. Directional Coupler: A component which directs a small portion of downstream RF energy to a port which can be connected to an antenna or another branch of distribution cabling, and also serves as a combiner of upstream energy between the tap port and through the connection port.
- G. Donor Antenna: The antenna, usually mounted on the outside of a structure where a DAS is installed, which picks up signals over-the-air from a donor source.
- H. Donor Source: The repeater, transceiver, cell site, or other radio site that produces signals which a DAS will relay and distribute.
- I. Emergency Responder Radio Antenna System [ERRAS]: A two-way radio communication system installed to assure the effective operation and coverage of radio communications systems for fire, emergency medical services, and/or law enforcement agencies within a building or structure. The system is not designed for use with District LMR, Cellular Services, or Wi-Fi Services.
- J. Federal Communications Commission [FCC]: federal agency responsible for implementing and enforcing America's communications laws and regulations.
- K. OET 65 Standards: The FCC's Bulletin that provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- L. Public Safety and/or First Responder: agencies which are charged with the responsibility of responding to emergency situations. These include, but are not limited to, law enforcement, fire departments, and emergency medical services.
- M. Reflected Power: Power which is reflected back along a transmission line as a result of discontinuities in line impedance caused at connectors or close proximity of metallic objects.
- N. Radio Frequency [RF]: Energy from electromagnetic waves, or alternating currents that produce electromagnetic waves, in the spectrum of radio frequencies (30 kHz to 300GHz)
- O. Signal Booster: See BDA

- P. Splitter: A passive component that has a single input port and two or more output ports, effectively splitting the signal equally amongst the output ports. It also serves to combine upstream signals from the "output" ports into composite signals at the "input" port.

1.8 SUBMITTALS

- A. Submittal procedures: See Section 28 05 00.
- B. Submit a complete submittal package within 30 calendar days, for approval, after award of this work. Equipment is not to be ordered without approval. Partial submittals are not acceptable for review. Each submittal shall include a dated transmittal.
- C. Submittal may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- D. Quality Assurance Submittal:
1. Letter from manufacturer stating that the Contractor is an Authorized Factory Distributor for the area where the project is located.
 2. The Contractor and Manufacturer shall supply sufficient information to indicate that the proposed system is based on the latest hardware, software technology and products comply with specified requirements and FCC Regulations.
 3. The system described in the submittals shall be certified by an FCC Licensed Designer and installation shall be supervised by an FCC Licensed Project or Installation Manager.
- E. Product Data Submittal including special boxes, cable and other material as requested by the Architect/Engineer including:
1. A cover sheet with the name and location of the project, the name, address and telephone number of the Contractor and the name, address, and telephone number of the submitting sub-contractor. Include on or after the cover sheet sufficient space for review stamps.
 2. Copies of FCC Licenses for both the Designer and Project or Installation Manger.
 3. An indication of any deviations from Contract Document requirements, including variations and limitations. Show any revisions to equipment layout required by use of selected equipment.
 4. A product data index and complete equipment list including for each product submitted for approval the manufacturers name and part number including options and selections.
 5. Cut-sheets or catalog data illustrating the physical appearance, size, function, compatibility, standards compliance, and other relevant characteristics of each product on the equipment list. Indicate by prominent notation (an arrow, circle, or other means) on each sheet the exact product and options being submitted for approval.
 6. Submit design data when the scope of work requires, including passband curves for both uplink and downlink for all bands, calculations, schematics, risers, sequences, or other data.
 7. Any resubmittal shall include a complete revised equipment list and any product data that is revised.
 8. Any rejected submittals must be corrected and resubmitted to the AHJ and Architect/Engineers within 10 days of receipt of the rejected material.
- F. Submit shop drawings locating all components of the system, indicating circuit routing, cable type, and gauge. Shop or coordination drawings shall include information that will allow to the Contractor to coordinate interdisciplinary work and when necessary guide the manufacturer or fabricator in producing the product. Shop or coordination drawings shall be specifically prepared to illustrate the submitted portion of work, this may require diagrams, schedules, details, risers, floor plans and accurate to scale, (minimum of 1/8" = 1'-0"), equipment and

device layouts prepared using a CAD or BIM engineering drawing program.

- G. Testing
1. Submit all field test records of the radio systems. These shall include, but not be limited to:
 - a. Preconstruction Tests – Tests performed with the AHJ prior to construction of the new facility to verify that the municipality has signal coverage in that area.
 - b. Mid-Construction Tests – Tests performed with the AHJ during construction once walls have been constructed and the exterior roof is installed.
 - c. Final Testing – Tests performed in conforming with IFC Section 510.5.3 and Section 510.6. This testing is to be signed off by the AHJ. Engineers shall also be present for the final testing process.
 2. All testing records shall be submitted with O&M information and close out documents.
 - a. Provide one (1) digital copy of all close out documents
 - b. Provide three (3) copies of closeout documents bound in a 3-Ring binder with dividers and table of contents.

1.9 QUALIFICATIONS OF A PROPOSED CONTRACTOR

- A. Proposed contractors who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified.
- B. The proposed contractor, as a business entity, shall be an authorized distributor and designated representative of the emergency responder radio coverage system manufacturer, with full warranty privileges, and shall have been actively engaged in the business of selling, installing, and servicing emergency responder radio coverage systems for a period of at least 5 years.
- C. Recently formed companies are acceptable only if specific pre-approval is requested, and granted by the Architect/ Engineer, based on experience of key personnel, current and completed projects, and all licensing requirements are met 10 working days prior to the contract proposal date.
- D. The Contractor shall employ factory trained technicians capable of supporting the maintenance of the system. No contract employees are allowed unless they have been to the factory service school within the last 18 months. A certificate of this training shall be provided with the Contractors submittal.
- E. The contractor shall employ full time local technicians and installers. The manufacturer shall maintain a full-time factory employed service staff for product support and service.
- F. The proposed Contractor shall have an office within 150-miles of the job site, staffed with trained technicians who are qualified and licensed to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up and perform a 100 percent operational audit of all installed devices, to instruct the Owners representatives in the proper operation of the system, and to provide service throughout the warranty period.
- G. All testing shall be conducted, documented, and signed by a person in possession of an FCC General Radio Telephone Operators License and be a full-time employee of contractor.
- H. The proposed contractor shall be fully experienced in the design and installation of the type of system herein specified and shall furnish with the contract proposal an itemized list of the installations of the type specified herein. The list shall include the name of the project, date of completion, the amount of the contract, the name, and telephone number of a qualified person

to contact for reference. This list must contain at least two (2) projects within a 150-mile radius of the school district to allow school administration officials to visit the job site for review of the system installation and service. Each reference project listed must utilize equipment by the same manufacturer as the proposed system.

- I. The Proposed Contractor shall not have any grievances or complaints of record regarding workmanship, code compliance, or service response. A Proposed Contractor that has any prior finding(s) of a code or license violation or has any litigation in process concerning the installation of a system is unacceptable.
- J. The ability of a proposed Contractor to obtain plans and provide a performance bond shall not be regarded as the sole qualification of the Contractors' competency and responsibility to meet the requirements and obligations of the contract.
- K. The Builder shall be satisfied that a proposed Contractor meets all the requirements expressed herein before including the Contractor's proposal in the project.
- L. The Owner may investigate, as they deem necessary to determine the ability of the proposed Contractor to perform the work. The proposed Contractor shall furnish to the Owner with any information or data requested for this purpose.
- M. The Owner reserves the right to reject any contract proposal if the evidence submitted, or their investigation, fails to indicate that the Contractor is qualified to fulfill of any part of the contract or to complete the work contemplated therein.
- N. The Owner reserves the right to reject the proposal of any Contractor who has previously failed to perform properly, or complete on time, contracts of a similar nature.

PART 2 – PRODUCTS

2.1 GENERAL

- A. The system shall conform to the requirements as identified in IFC Section 510.4 and Section 510.5. Testing records are required to confirm performance of the system.
- B. Compatibility: The equipment, including but not limited to repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna systems, etc., shall not interfere with the existing communication systems utilized by the Public Safety and First Responder agencies.
- C. Power Supplies: At least two (2) independent and reliable power supplies shall be provided: one primary and one secondary. The primary power source shall be supplied from a dedicated 20-ampere branch circuit and comply with 4.4.1.4 of NFPA 72. The secondary power source shall be a dedicated battery back-up, capable of operating the in-building system for at least 24 hours at 100% operation. The battery system shall automatically charge in the presence of external power input. The battery system shall be contained in one NEMA 4 type enclosure. Monitoring the integrity of the power supplies shall be in accordance with 4.4.7.3 of NFPA 72.
- D. Survivability
 - 1. Fire Performance: All main risers or trunks of the antenna system shall be installed with resistance to attack from fire using one of the following methods:
 - a. A 2-hour fire rated cable or cable system
 - b. Routing the cable through a 2-hour fire rated enclosure(s) or shaft(s).
 - 2. Cabinet: The signal booster and all associated equipment shall be housed in a single NEMA 4 certified, painted steel weather tight box. The cabinet shall be large enough to

dissipate internal heat without venting from inside of the cabinet to outside atmosphere. Equipment installed on the roof of structures shall be rated for the expected extreme temperature and weather associated with rooftop installation.

3. Rooftop Installations shall require a Pitch Pocket for proper weather-tight roof penetrations.
4. Passive equipment: Passbands shall be VHF, UHF, and 700-900 MHz, IP rating of 2GHz.

2.2 SYSTEM COMPONENTS

- A. Signal Strength
 1. Downlink: A minimum signal strength of -95dBm shall be provided throughout the coverage area.
 2. Uplink: A minimum signal strength of -95 dBm shall be received at the local municipality from the coverage area.
 3. A donor antenna must maintain isolation from the distributed antenna system. The donor antenna signal level shall be a minimum of 15 dB above the distributed antenna system under all operating conditions.
- B. Permissible Systems
 1. Buildings and structures shall be equipped with an FCC Certified Class B Bi-Directional VHF, UHF, and 700-900 MHz amplifier(s) as needed.
 2. The distributed antenna system may utilize a radiating cable, fixed antennas, or a combination of both.
- C. Supported Frequencies: The system shall support VHF, UHF, and 700-900 MHz as required for local public safety and first responder bands as utilized by the local municipality.
- D. Reject Filters: Notch filter sections shall be incorporated as necessary.
- E. Band Migration Capability: The signal booster shall include re-tunable or replaceable filters to accommodate rapid and economic passband changes in the event of mandatory FCC changes with the NPSPAC band. The use of non-adjustable and non-replaceable RF input and output filters is prohibited.
- F. Output Level Control: An automatic output leveling circuit shall be included for both passbands with a minimum dynamic range of 60 dB, less any gain reduction setting, to maintain FCC out of band and spurious emission compliance.
- G. Degraded Performance in Emergencies: The system shall be designed to allow degraded performance in adverse conditions, such as abnormally high temperatures resulting from nearby fires, extreme voltage fluctuations and/or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) shall not be implemented as the standard mode for public safety applications.
- H. Mode of Operation: The system shall be normally powered on and shall continuously provide passing of frequencies within the Public Safety and First Responder bands.
- I. All in-building radio systems shall be compatible with both analog and digital communications simultaneously at the time of installation.

2.3 SYSTEM MONITORING

- A. The distributed antenna system shall include connections to the fire alarm system to monitor the operational integrity of the signal booster, power supplies and annunciate malfunctions on

the fire alarm system. Coordinate and provide this integration, as part of this system, with the fire alarm system contractor that is authorized to service the facility's fire alarm system. The integration of the DAS with the fire alarm system shall comply with Chapter 10 of NFPA 72.

- B. A sign shall be located at the fire alarm panel with the name and telephone number of the local municipality indicating that they shall be notified of any failures that extend past the 2-hour time limit.
- C. A dedicated supervised monitoring panel shall be provided within the emergency command center or other location as designated by AHJ to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:
 - 1. Normal AC power
 - 2. Signal booster trouble
 - 3. Antenna Failure
 - 4. Loss of normal AC power
 - 5. Failure of battery charger
 - 6. Low battery capacity

2.4 CABLE ROUTING, INSTALLATION, AND SUPPORT

- A. System wiring, and equipment installation shall be in accordance with good engineering practices. Wiring shall meet all state and local electrical code requirements.
- B. Wires and cables shall enter each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.
- C. Cable pathways, conduit, and cable support systems shall be complete with bushings, deburred, cleaned, and secure prior to installation of cable.
- D. Before energizing the system check all cables for correct connections and test for short circuits, ground faults, continuity, and insulation.
- E. In all exposed areas such as mechanical rooms, parking garages, stairwells, etc., cable shall be fully enclosed in conduit.
- F. Do not attach any supports to joist bridging or other lightweight members. The support system shall provide a protective pathway to eliminate stress that could damage the cabling.
- G. Mount all equipment firmly in place such that vibration or jarring will not interfere with system operation. Route cable in a professional, neat, and orderly installation.
- H. The cable shall not be crushed, deformed, skinned, crimped, twisted, or formed into tight radius bends that could compromise the integrity of the cabling.
- I. Cable must not be fastened to electrical conduits, mechanical ductwork or piping, sprinkler pipes, or routed to obstruct access to hatches, doors, utility access panels, or service work areas. Do not route cables through fire doors, ventilation shafts, grates, or parallel for more than four-feet with line voltage electrical conductors. System cables shall not be run loose on ceiling grid or ceiling tiles.
- J. Provide for adequate ventilation to all equipment housings and take precautions to prevent electromagnetic or electrostatic hum.

- K. All conduit, duct, track, and raceway runs shall be spaced apart to allow for maintenance, such as the installation of couplings, without disturbing adjacent pathways.
- L. Each cable run shall be free of splices. No terminations, splices, or equipment will be installed in or above ceilings.
- M. Do not route any communication cable within two feet of any light fixture, HVAC unit, service access area, electric panel, or any device containing a motor or transformer.
- N. System cable will not be installed in the same conduit, duct, or track with line voltage electrical cable.
- O. Any pulling compounds utilized must be approved by the cable manufacturer and shall not degrade the strength or electrical characteristics of the cable.

PART 3 EXECUTION

3.1 COORDINATION

- A. Contractors shall coordinate with an FCC licensed engineering firm regularly employed in the business of designing and implementing Emergency Responder Radio Antenna Systems for emergency responders.
- B. Electrical Work:
 - a. Proposed Contractor is required to provide for and coordinate with Electrical Contractor for any, and all required electrical work, including but not limited to, circuiting, conduits, back boxes, and more. These expenses will not be included in the electrical contractor primary bid.

3.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment model and serial identification numbers.
- B. Store and protect equipment in a conditioned space until installation.

3.3 SYSTEMS INSTALLATION

- A. Coaxial antenna cabling shall not be installed in the same conduit, raceway, or cable trays used for other systems.
- B. All equipment shall be connected according to the OEM's specifications to insure correct installation and system performance.
- C. Coordinate all roof penetrations with General Contractor and/or Roofing Contractor.

3.4 GROUNDING

- A. Ground cable shields and equipment per Manufacturer's requirements.
- B. Antenna mast shall be grounded per NFPA 70 NEC requirements and antenna manufacturer's requirements. Provide grounding blocks and surge protection for outside coaxial cabling. Bond the antenna mast to the existing lightning protection system.

3.5 TESTING, WARRANTY SERVICE

- A. A factory trained representative of the manufacturer shall supervise the final connections and

testing of the system and it shall be subject to the final acceptance of the Architect/Engineer and Owner. All testing shall meet the testing standards set forth in IFC Section 510.

- B. This contractor will thoroughly test all components of the systems and devices proposed herein to assure equipment specifications are met. This contractor will start up, test, and debug systems to ensure that all aspects of the system are working, documented, and reporting properly.
- C. This Contractor shall make a thorough inspection and test of the complete installed Emergency Responder Radio Antenna System including all components and controls to ensure the following:
 - 1. Complete and functional system.
 - 2. Installed in accordance with manufacturer's instructions.
 - 3. Verify proper operation and processing of signals.
 - 4. Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.
 - 5. Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense.
- D. A final System Acceptance Test shall be performed in the presence of a designated Owner representative and the AHJ. In the event that a system does not pass or only partially passes the Acceptance Test, the Project Manager will file a discrepancy report. Corrected items will be re-tested via a punch list to ensure that they comply with the system requirements.
- E. This Contractor shall provide a warranty of the installed system against defects in material or workmanship for a period of one (1) year from the date of substantial completion. Any equipment, cabling or wiring shown to be defective shall be replaced, repaired, or adjusted free of charge. All labor and materials shall be provided at no expense to the Owner. All equipment will carry a one-year warranty or manufacturer's warranty whichever is greater.
- F. Immediately prior to the end of the warranty period, the system shall be inspected and certified for the following year at no additional cost to the Owner.

3.6 DRAWINGS, MANUALS, AND TRAINING

- A. As-built drawings and operating and maintenance manuals may be electronically transmitted in PDF file format (preferred) or paper copies may be provided in quantities indicated in Division 1. Paper copies shall be organized including index tabs in a 3-ring black binder of sufficient size.
- B. Upon completion of the installation, and prior to final inspection, the Contractor shall furnish as-built drawings.
- C. In addition, the contractor shall furnish complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets. Manuals shall include wiring diagrams to indicate internal wiring for each device and the interconnections between the items of equipment. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system. Provide a parts list with manufacturer and model number for commonly replaced parts. Include complete instructions for the inspection, testing, and maintenance of the system. Include copies of all calculation sheets used to configure the system.
- D. Formal on-site training sessions shall be conducted by the Emergency Responder Radio Antenna System contractor. It shall be the responsibility of the Contractor to coordinate time

and location of training sessions with the Owner. Provide documented general instruction as follows:

1. Provide instruction to the maintenance personnel to include the location, inspection, normal maintenance, testing, and operation of all system components. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.
2. Provide instruction to designated personnel on the functions and operation of the system provided including capabilities, limitations, and the meaning of status messages. State the proper procedure for testing, routine maintenance, and request for service. Provide detailed instruction on the operation of the system. Provide a minimum of four (4) hours—two 2-hour sessions separated by a minimum of two weeks.

END OF SECTION

SECTION 28 13 00 - ACCESS CONTROL SYSTEM

CONDITIONS OF THE CONTRACT AND DIVISION 01, as applicable, apply to this Section.

PART 1 – GENERAL

Unless noted otherwise, "Contractor" or "This Contractor" refers to the Security Contractor.

1.1 SUMMARY

- A The Contractor shall provide and install a new access control system at the facility, providing all components and programming necessary for a turnkey expansion. Refer to the technology drawing sheets for exact locations and other requirements.

1.2 SCOPE OF WORK

- A Provisions of Section 27 10 00, previous sections, and Construction Documents are included as a part of this section as though bound herein.
- B The contractor shall include in his bid the cost of all other trades required to install a complete access control system.
- C It is the intent of the contract drawings and specifications that the contractor provides an installation complete in every respect. In the event that additional details or special construction is required for work indicated or specified in this or other sections, it shall be the responsibility of this contractor to provide all material and equipment which is usually furnished with such system in order to complete the installation, whether mentioned herein or not.
- D These specifications are accompanied by drawings indicating some devices and details of the installation. The drawings and specifications are complementary to each other, what is required by one shall be binding as if required by both.
- E If the contractor deems any departure from the drawings necessary, details of such departure and reasons therefore shall be submitted to the Owner's representative for approval.
- F Should the drawings disagree in themselves or with the specifications, the better quality of work and materials shall be estimated. Notify the Owner's representative of disagreement prior to the start of any installation.

1.3 RELATED WORK

- A Section 27 10 00 – STRUCTURED CABLING SYSTEM
- B Section 28 23 00 – VIDEO SURVEILLANCE SYSTEM
- C Section 28 31 00 – FIRE ALARM SYSTEM

1.4 SYSTEM DESCRIPTION

- A The access control system shall consist of all detection devices, control panels, security terminals (keypads), power supplies, notification appliances, signaling devices, zone expansion modules, equipment cabinets, water detection devices, proximity card readers and any auxiliary components installed, wired, or otherwise connected in accordance with the drawings, this specification, and the manufacturer's specifications to function as intended. It is the intent of these specifications to provide an installation at each site which is complete in every respect. In the event that any additional details or special construction is required for the work intended, it shall be the responsibility of the contractor, whether mentioned herein or not. The drawings indicate approximate locations of some devices. Verify final location of devices with District prior to rough-in. The contractor shall be responsible for determining the final layout and exact placement of the system components to ensure coverage which fully satisfies the intent of these specifications and is at least as complete as that reflected on the drawings.

1.5 QUALITY ASSURANCE

- A Utilizing standard products and pieces, components of the system shall be listed and labeled as products of a single manufacturer under the appropriate category by Underwriter's Laboratories, Inc.
- B The system shall be engineered by a factory trained, authorized representative and licensed installer.
- C Local availability of parts and service is a requirement for bidding. Parts must be available locally, within a 75-mile radius of the jobsite.

1.6 SUBMITTALS

- A In addition to complying with the submittal requirements described in sections 27 10 00. Contractor shall submit to and receive approval from the Owner's representative, three copies of the following information:

1. **Line by line specification review stating compliance or deviation.**
2. Manufacturer's technical product data on all components and miscellaneous materials. Include module space requirements on the motherboard and/or in the cabinet, and data substantiating that the equipment will comply with the requirements.
3. A written system description detailing all modules and/or components of the system, with particular emphasis on conformity to this specification.
4. Written system sequence of operation detailing all operational aspects of the system.
5. CAD generated riser diagram, point-to-point wiring diagrams and floor plans, at the same scale as the contract documents, showing the location of all control panels, devices, power supplies, interconnecting wiring, zoning and proposed addressing with nomenclature read-out to be used.
6. Calculations for battery sizing requirements.
7. Submit to and receive approval from the Special Systems section of the Maintenance department, three copies of the following information:
 - a. CAD generated riser, point-to-point wiring diagrams and floor plans, at the same scale as the contract documents, showing the location of all control panels, devices, power supplies, interconnecting wiring, zoning and proposed addressing with nomenclature read-out to be used.

1.7 CONTRACTOR QUALIFICATIONS

- A. The contractor shall be an authorized representative of the manufacturer.
- B. The contractor shall be licensed to install, modify and service the system.
- C. Field technicians must have a minimum of 4 years of experience.
- D. Any other personnel will be directly supervised on a one-on-one basis.
- E. Maintain a complete service organization within a 75-mile radius of Project Site.

1.8 OPERATIONS AND MAINTENANCE DATA (CLOSE OUT DOCUMENTS)

- A. Furnish one data-programming disk with all system software required for a re-start after a traumatic failure. Software must be of appropriate and compatible update version for the firmware installed.
- B. Furnish two electronic and three paper copies of "As-Built" drawings at the same scale as the contract documents with riser, point-to-point wiring diagrams, partitioning, wire routing,

color coding of conductors, and any unspecified information that would be beneficial to the Owner for future planning or to technicians for system troubleshooting, and floor plans showing the location of all control panels, devices, power supplies, interconnecting wiring, zoning and addressing with nomenclature read-out used.

- C. Terminations, junction points and splices shall be clearly recorded on the as-built drawings.
- D. The locations of the "end of line" devices shall be clearly marked on the as-built drawings.
- E. Detector alarm initiating loop resistance readings shall be recorded on the as-built plans.
- F. Furnish three copies, for each component:
 - 1. Equipment operations manuals.
 - 2. Equipment maintenance and testing manuals.
 - 3. Equipment data and parts lists.
- G. Furnish three signed letters of guarantee, which specifies the substantial completion date and the guarantee period.

PART 2 - PRODUCTS

A. MANUFACTURERS

- Access Control System Hardware/Firmware/Software: Vanderbilt Industries Security Management System (SMS) as manufactured by Vanderbilt Industries.
- Magnetic Card Readers: compatible with existing Southwestern campus cards.

2.1 SERVER

- A. The server is existing and will require additional programming to accept the new panels. The programmer will be required as on-site programming and not remote programming for security purposes, unless written approval has been granted by the system administrator.

2.2 COMPONENTS

A. SMS Software Capabilities

- 1. The SMS Software shall support 64,000 card readers, 512,000, input points, intrusion detection points, and relay outputs. The SMS database server shall support an unlimited number of cardholders, and visitors, limited only by the available memory on the SCP.

The database server shall also support an unlimited number of system events and System Operator transactions in the history file limited only by available hard disk space. Client Workstations shall be limited only by the limitations of the operating system server software.

2. SMS Software Functionality

a. Time Intervals

- I. The SMS shall be capable of creating and storing an unlimited number of Time Intervals, limited only by the available hard drive space.
- II. Each Interval may be defined with a 50 character name.
- III. Each Interval will consist of a start time, an end time and the selected days the interval is to be active. Selected from a 15 day per week Calendar consisting of Sun thru Sat for 7 days and 8 Holiday Types / Categories which together will produce the 15 day per Interval Week for the individual Time Interval. Time Intervals shall be allowed to belong to any or all Time Zones so that the Time Interval only has to be defined once.

b. Time Zones

- I. The SMS shall be capable of creating and storing up to two hundred fifty five (255) time zones. Each time zone shall have a minimum of Twelve (12) Time Intervals. Each Time Interval shall be assignable to each and every Time Zone.
- II. Each time zone shall be assignable to an alphanumeric name of up to 50 characters. Time zones shall be applied to access levels, card reader modes, alarm inputs, and alarm outputs. Time zones shall be allowed to belong to any or all access levels so that the time zone only has to be defined once.

3. Access Levels

- a. The SMS shall be capable of defining a minimum of 32,000 access levels with a minimum of 32 access levels per cardholder card. Access Levels shall consist of a combination of card readers and time zones.
- b. Each Access Level shall be assignable to an alphanumeric name using up to 50 characters.
- c. Card readers shall have the ability to be assigned to any or all access levels defined in the SMS. Individual card readers shall be capable of having a distinct time zone assigned to it.
- d. The SMS shall allow a 'First Card Unlock' option to be assigned on a Combination of Time Zone and Allowed Card Group.

4. Temporary Access Levels shall be enabled at the Site level.

- a. The SMS shall be capable of assigning Temporary Access Levels inclusive of the 32,000 assignable Access Levels.
 - b. Each Temporary Access Level shall be assignable to an alphanumeric name using up to 50 characters.
 - c. Each Temporary Access Level shall be definable with a start and end date.
 - d. Temporary Access Levels shall be stored in the SCP and functionality shall be maintained in the event of disconnection with the SCP.
5. Precision Access is enabled at the Site level and allows each Cardholder to have a Time Zone assigned separately for Access to each Reader.
6. Holidays
- a. The SMS shall provide a minimum of 255 Holiday assignments using an embedded calendar. Holidays shall be assigned an alphanumeric name using up to 50 characters and shall be grouped into eight (8) types of holidays, and shall be assignable individually. Access rights, card reader modes, and schedules must be able to be altered when the current date is designated a Holiday.
 - b. Daylight Savings Time changes shall take effect automatically, based on the SMS Server time which may be synchronized using an NTP Server or the NIST Time synchronization.
 - c. The SMS shall support Holiday Ranges that allow a single holiday to span across multiple calendar days.
7. First Card Unlock
- a. The SMS shall provide a First Card Unlock feature that when configured retards a pre-determined time zone activated unlock command until a valid credential has been presented and granted access to the portal.
8. Database Segmentation
- a. The SMS shall be required to support data Sites (segmentation, partition) whereby each Site (segmentation, partition) shall have its own set of cardholders, field hardware and system parameters (time zones, access levels etc.). This Site (segmentation, partition) shall expand the limitations of the SMS parameters (i.e. access levels and time zones) to the maximum capacity of each parameter multiplied by the number of Sites. The following list shall be made available for segmentation:

2.3 FIELD DEVICES

A Proximity Readers

Card reading devices shall be available in Proximity and Pin and Proximity formats. A

mullion variant will be available with pin and proximity options. Readers shall be tested to withstand 5 joules of impact to IK08 Standard. Configurable light bar indicators shall indicate power status, valid and invalid reads. The card reader will give an audible indication of each read. Readers will have a minimum read range of 25mm in normal operating conditions. Readers shall be suitable for indoor and outdoor use with a rating of IP55 or greater. A USB reader shall be available to be used with ACTEnterprise software application. 3.2

B. Reading Protocols

Card reading devices shall read contactless Smart Card 13.56MHz MIFARE DESFire EV1 and EV2 technology conforming to standards compliant ISO/IEC 14443-4. Proximity readers will support Open Supervised Device Protocol (OSDP). Proximity readers will also be available to support 125KHz standard PROX formats. 3.3

C. Bluetooth Readers

Bluetooth® Low Energy (BLE) readers offer a secure and flexible identification solution bringing mobile access credentials to Android™ and iOS® smartphones. Readers support MIFARE Classic, MIFARE Plus®, MIFARE® DESFire® EV1, EV2. Data encryption with 128-bit AES encryption and randomization is supported. Readers can support cards and pins and are IP65 Rated. Approvals: Bluetooth SIG, CE, RoHS, REACH and FCC 3.4

D. Biometric Readers

Fingerprinting Biometric Readers shall be installed with ACTEnterprise 2.11 software application. Readers shall support a 34-bit wiegand format and TCP/IP protocol. Readers of metallic casing and are IP65 rated. Readers shall be mounted internally or externally. Fingerprint templates are captured via a USB enrollment reader directly into ACT Enterprise Software. Templated can be transmitted to any other Bluetooth devices on the TCP/IP network.

2.4 CABLE

- A. Composite cable is allowed, although sufficient conductors may not be available in composite cables for all portal configurations. Contractor shall be responsible for additional required cables beyond one composite cable to each portal to meet functional requirements of the system.
 - i. Duress, and LockDown: 22 AWG, 2 conductor, stranded.

- ii. Control Cabling: 18 AWG, 4 conductor, stranded.
- iii. Auxiliary Devices: Refer to plans for requirements

B. Locks and Door Hardware:

- i. Electric/electronic locks shall be furnished and installed by the Access Control Contractor.
- ii. Access Control Contractor shall interface with and terminate cables to locks.
- iii. Access Control Contractor shall coordinate with door hardware provider for specified sequences of operation at the various portals.
- iv. Electrified cylindrical and electrified mortise locks shall have an integrated request-to-exit device
- v. Electric strikes shall have an integrated latch bolt monitor, and the dead latch shall be seated properly so that the strike cannot be defeated by manipulation.
- vi. Magnetic locks shall have a magnetic bond sensor
- vii. Refer to architectural specifications and/or the architectural door schedule

PART 3 – EXECUTION

3.1 INSTALLATION

- A. All wiring shall be in accordance with the California Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.
- B. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with CEC Article 760 if so approved by the local authority having jurisdiction.
- C. No AC wiring or any other wiring shall be run in the same conduit as security alarm wiring.
- D. Network controllers shall be installed centralized in telecommunications room(s). Mount controllers to the structural walls in a location coordinated with other utilities. Coordinate exact location in field prior to installation. Provide dedicated +120 VAC power circuit to the controllers using #12 AWG wiring from the nearest electrical power distribution panel board.

- E. All wire shall be installed in an approved conduit/raceway system (except where permitted by CEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per CEC.
- F. Minimum conduit size shall be 3/4" EMT. Provide engineered shop drawings for approval prior to installation.
- G. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
- H. Contractor is required to provide all mapping and software configuration required to operate system as per manufacturer's recommendations.
- I. All low voltage access control cabling shall be installed in dedicated conduit in wall and free air in attic using cable tray and non-continuous cable support pathways to the fullest extent possible. Cable support shall be spaced per code

3.2 CABLE PATHWAYS

- A. Cable Support:
 - 1. All wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
 - a. Approved Cable Support Product:
PANDUIT® Corporation J-MOD™ modular support system (sized appropriately for the number of wires being installed. Reference the manufacturer's specifications for the suggested maximum cables per support size.
 - 2. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount the J-MOD™ support hook to the treaded rod.
 - 3. J-MOD™ cable support shall be installed at a maximum of 5' on center.
 - 4. All cable installed shall be attached to the J-MOD™ support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each J-MOD™ cable support to keep wires neatly bundled throughout the entire run. Tiewraps will only be allowed to be used inside the control panels as required to manage the wires within each type of panel.

5. **ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING'S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.**
6. **IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO INSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON THE INSTALLED WIRING.**

B. Conduit / Raceway:

1. All wire shall be installed in an approved conduit/raceway system (except where permitted by CEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per CEC.
2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per CEC.
3. Minimum conduit size shall be 3/4" EMT. Install conduit per engineered shop drawings.
4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
5. All conduit ends shall have a protective bushing to prevent cable damage. BUSHINGS MUST BE INSTALLED PRIOR TO INSTALLING CABLE. CUTTING BUSHING TO INSTALL AROUND INSTALLED CABLES WILL NOT BE ACCEPTED.

3.3 TESTING

- A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, Electrical Contractor and performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to substantial completion.
- B. Provide instruction as to proper use and operation of system, for the Owner's designated personnel.

3.4 WARRANTY

- A. Entire system shall be warranted against defects in materials and workmanship for a period of one (1) year from the date of substantial completion.

3.5 SOFTWARE

- A. Provide two electronic copies of the final programming and program software to the Owner's Security Supervisor after final approval.

3.6 LABELING

- A. Identify the panel and circuit number within the cabinet served.
- B. Identify the load served on the electrical panel directory.
- C. Cables, detectors, panels, enclosures, addressable modules and auxiliary power supplies shall be labeled indicating system zone, partition or circuit identification and accurately reflected on the as-built drawings.
- D. Color coding of conductors shall be consistent throughout the installation, as follows:
 - 1. DC power circuits shall be red for positive leads and black for negative leads.
 - 2. Alarm initiating loops shall be white for positive conductors and green for negative conductors.

3.7 CONTROL PANEL

- A. No programming sequences, codes or passwords shall be entered into the operation software of the system to prevent the Owner from access to all available system operating functions or system microprocessor programming.
- B. Any peripheral devices, software, passwords, programming codes, manuals, adapters, etc., necessary for programming any part of the system shall be provided as a condition of the contract.
- C. Control functions shall be programmed as directed by Special Systems.
- D. The control panel(s) shall be earth grounded in strict accordance with the manufacturer's specifications.

- E. Power supply shall be installed directly below security panel.

END OF SECTION

SECTION 28 23 00 – VIDEO SURVEILLANCE SYSTEM

PART 1 GENERAL

1.01 SCOPE

- A. Refer to Section 27 00 00 for additional project scope information. (Note to specifier: Add specific scope requirements by section on project-by-project basis.)

1.02 RELATED WORK

- A. Division 14 - General Elevator Requirements
- B. Section 27 00 00 – Basic Materials and Methods
- C. Section 27 60 00 – Physical Security General Requirements
- D. Section 28 16 00 – Access Control System

1.03 REFERENCE

- A. In addition to any requirements below, Contractor shall abide by requirements delineated in 27 00 00 including but not limited to:
 - 1. General: Definitions, reference standards and codes, qualifications, pre-construction submittals, construction progress submittals, closeout submittals, and correction period.
 - 2. Products: Substitutions, product specifications, miscellaneous material, cable, connectors, power devices, and interface panels.
 - 3. Execution: Coordination, testing, training, warranty, and cable management.

1.04 GENERAL SUMMARY

- A. System shall include IP cameras and a server-based NVR with client stations and storage as described in this section and on the drawings.
- B. The Category 6 cabling to each camera and patch cords shall be provided by the structured cabling Contractor.
- C. System installation shall include, but not be limited to, installation, programming, and configuration of system components as well as all associated software upgrades, patches, and maintenance for three years.
- D. Contractor is responsible for meeting with Owner's representative at time of camera installation to verify exact placement and view of each camera to ensure coverage area is as intended.
- E. Contractor shall coordinate with owner and provide labor and licenses to integrate new cameras into owner's existing Video Insight VMS. VMS software specification provided for reference only.

1.05 DRAWING SHEETS

- A. All cameras are designated with a C symbol on the project drawings.

1.06 MOUNTING AND INSTALLATION

- A. Contractor shall provide the appropriate mounting hardware for all ceiling types and wall types where cameras shall be located. Plastic anchors of any type are not allowed.
Wall mounted 180-degree cameras shall be mounted on a wall arm and all exterior cameras.
- B.
- C. Specification Compliance: A letter shall be provided stating, by section and subsection, that the SCS installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT
- D. Cameras mounted on a drop tile ceiling shall have a tile support bridge with a steel support cable connected to structure to prevent theft and vandalism. Camera shall be mounted to the back box on the tile bridge, no toggle bolts or other screw in hardware are permitted.

1.07 CODE AND STANDARD REQUIREMENTS

- A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association and any other codes as required by the AHJ.
- B. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.
- C. Cameras shall meet the following
 - 1. standards: MPEG-4:
ISO/IEC 14496-10 AVC (H.264)
Networking:
 - 2. IEEE 802.3af (Power over Ethernet)
 - 3. Network Video:
ONVIF Profile S or better

PART 2 PRODUCTS

2.01 VMS SERVERS

- A. VMS server hardware to be provided by owner. Contractor shall coordinate with owner to add new cameras to existing system.

2.02 VMS VIDEO RECORDERS

- A. The Contractor shall provide and install additional video recording servers for maintaining throughput and storage requirements to support additional cameras and devices herein. Storage, framerate, motion, etc. shall be coordinated with owner. Contractor shall replicate owner's existing standard for new cameras.
1. Video Management System Recorders shall be enterprise grade physical server(s).
 2. Recorders shall be equipped with Intel Xeon Processors, E5 series, latest generation.
 3. Servers shall use enterprise class Serial Attached SCSI (SAS) (SAS) hard drives with a minimum MTBF of 1 million hours and error recovery time limit of approximately 8 seconds or less. Enterprise class SATA hard drives may be used when connected to a SAS backplane.
 4. Servers shall utilize SSD drives in a RAID-1 for the Operating System and server software.
 5. Server shall utilize RAID-5 for the video recorder drives.
 6. Server shall have a minimum of 32gb of Registered ECC RAM.
Server shall be equipped with Quad NIC ports in a dual teamed configuration.
 7. Server shall operate on Windows Server Standard 2019 operating system. Non-server version OS is not approved.
 9. Servers shall include a rack-mountable chassis. Workstations or computers are forbidden to be used.
 10. Server(s) shall be provided with a 5-year parts and labor warranty.
- Refer to the VMS Video Storage Requirements section for recording requirements and criteria.
- B.
- C.

2.03 DIGITAL IP CAMERAS

- A. General:
1. All cameras shall be time synced to the Owner's NTP server.
The Contractor shall select the appropriate mounting hardware for the situation.
 2. All cameras shall be equipped with remote autofocus or autoback focus with the exception of 180/360 degree cameras and encoded analog cameras.
Multi-sensor 180 and 360 cameras shall have each sensor optimally calibrated
 4. independently to the conditions.
 5. All cameras shall be vandal proof and appropriate for the environment it is being installed in.
 6. All cameras shall have the latest VMS recommended firmware installed and all cameras of the same model shall have matching firmware versions.

7. The contractor shall coordinate with the owner for IP addressing, network configuration and multicast network configuration.
8. All cameras regardless of manufacturer/model shall have a consistent user name and non- standard password set. This shall be documented and provided to the owner and consultant prior to inspections.
9. The camera requirements below represent general performance criteria. Approved equals will have slight differences in specifications. The Owner and Consultant have complete discretion to reject approved equals that stray too far from the minimum requirements.

B. Camera Type 1 (Fixed Dome Interior - Typical) shall:

1. The Fixed Dome Camera shall deliver H.265 stream and H.264 stream.
2. The Fixed Dome Camera shall produce a resolution of 1,920 x 1,080 pixels (Full HD 1080p) at up to 60 fps with a 16:9 aspect ratio.
3. The Fixed Dome Camera shall produce a resolution of 2,048 x 1,536 pixels at 30fps with a 4:3 aspect ratio.
4. The Fixed Dome Camera shall utilize an approximate 1/3 type high sensitivity MOS image sensor.
5. The Fixed Dome Camera shall feature a 144dB wide dynamic range based on Enhanced Super Dynamic and Adaptive Black Stretch technology (ABS).
6. The Fixed Dome Camera shall produce a color image with a minimum illumination of 0.012 lux and a monochrome image with 0.006 lux at F1.6, maximum shutter of 1/30s and High gain mode.
7. The Fixed Dome Camera shall offer a built-in IR illumination to produce a clear monochrome image in zero lux conditions with 30m (98feet) irradiation distance.
8. The Fixed Dome Camera shall generate multiple simultaneous video streams of up to four.
(4) H.265 (Main profile) or H.264 (High profile) streams and JPEG streams.
9. The Fixed Dome Camera shall be equipped with intelligent auto mode, the technology for shooting license plate and person's face more clearly.
10. The Fixed Dome Camera shall be equipped with GOP control and Smart Facial coding which control an image quality of a stationary area, a moving area and a face, as bitrate reducing technology.
11. The Fixed Dome Camera shall produce encrypted stream.
12. The Fixed Dome Camera shall realize SSL / TLS communication with CA certificate.
13. The Fixed Dome Camera shall offer Video Motion Detection (VMD) with four (4) programmable detection areas, 15 steps sensitivity level and 10 steps detection size.
14. The Fixed Dome Camera shall have Fog compensation function.
15. The Fixed Dome Camera shall have High light compensation (HLC) function.
16. The Fixed Dome Camera shall have Super Chroma Compensation (SCC) which r

- realizes a better color reproducibility in the low illumination.
17. The Fixed Dome Camera shall provide up to eight (8) areas of electronic privacy masking.
 18. The Fixed Dome Camera shall offer the prioritized stream control which transmits a video stream to a specified client PC or recorder preferentially.
 19. The Fixed Dome Camera shall have a SD memory card slot that supports SD, SDHC and SDXC memory card for local storage.
 20. The Fixed Dome Camera shall offer full-duplex bi-directional audio communication capability between the camera and monitoring site.
 21. Manufacturer and model:
 - a. Camera Type 1:
 - i. Panasonic WV-S3531L Fixed Dome Network Camera
 - ii. Or approved equal
- C. Camera Type 2 (Multi-Directional 180/270/360 Degree Camera) shall:
1. The camera shall provide 360-degree field of view and produce video in quad view mode. It shall also provide digital PTZ along with automated video analytics to allow users to efficiently monitor large visual fields with capability to focus on certain areas when suspicious activity is observed.
 2. Video Compression and Transmission – The multi-directional camera shall have the following properties relating to the video signals it produces.
 - a. H.265, H.264 and MJPEG compression, each derived from a dedicated encoder and capable of being streamed independently and simultaneously
 - i. H.265 and H.264 – Maximum of 30 fps at all resolutions
 - ii. MJPEG – Maximum of 30 fps
 - b. The multi-directional camera shall be able to configure up to 10 independent video stream profiles with differing encoding, quality, frame rate, resolution, bit rate, and other video settings.
 - c. The multi-directional camera shall have four lenses and each lens shall provide the following resolutions.
 - i. 2560 x 1920 (5M), 2560 x 1440, 1920 x 1080, 1600 x 1200, 1280 x 1024, 1280 x 960,
 - d. 1280 x 720, 1024 x 768, 800 x 600, 720 x 576, 720 x 480, 640 x 480, 320 x 240
 - i. Simultaneous unicast access by up to 20 users
 - ii. Multicast or unicast capable
 - iii. Dynamic DNS (DDNS) support.
 - e. The multi-directional camera shall provide smart codec (WiseStream, Dynamic GOV, and Dynamic fps) to efficiently manage bit rate of the video stream and reduce storage while producing video quality that is visually equal to the one without smart codec.

- i. Viewing composition: Quad view
- 3. Camera – The multi-directional camera device shall have the following physical and performance properties:
 - a. IK10 rated for protection against impacts.
 - b. IP66 for protection against dust and water.
 - c. Auto day/night operation with removable IR cut filter
 - i. Low light level operation to 0.07 lux (color) and 0.007 lux (black and white)
 - d. 2D and 3D digital noise reduction
 - e. 32 privacy masking regions utilizing polygons
 - f. The multi-directional camera shall be able to capture high contrast scenes with 120 dB multi-exposure wide dynamic range.
 - g. One touch (Simple) or manual focus controllable remotely via network. The camera shall have motorized varifocal lens.
 - h. Advanced digital image stabilization with built in gyro sensor. The camera shall be able to measure movements in three axes and accurately enhance images from distortions caused by instability.

Intelligence and Analytics – The multi-directional camera shall have a suite of integral intelligent operations and analytic functions to include:

- a. Motion detection with eight definable detection areas, minimum/maximum object size definition and a learning algorithm that ignores false alarms such as trees and waves
on water. The camera shall also be able to send meta-data to NVR or VMS to allow users to search for motion events and generate video summary.
- b. Detection of logical events of specified conditions from the camera's video input
 - i. camera tamper (scene change)
 - ii. loitering
 - iii. directional detection
 - iv. defocus detection
 - v. fog detection
 - vi. virtual line
 - vii. enter/exit
 - viii. appear/disappear
- 5. Interoperability – The multi-directional camera shall be ONVIF Profile S compliant.
- 6. The multi-directional camera shall possess the following further characteristics:
 - a. Built-in web server, accessed via standard browsers including Internet Explorer, Firefox, Chrome & Safari

- b. Micro SD/SDHC/SDXC memory card options, with configurable pre-alarm and post- alarm recording intervals
 - c. Alarms and notifications
 - i. alarm notification triggers:
 - ii. alarm input
 - iii. motion detection
 - iv. video analytics
 - v. network disconnect
 - vi. available notification means upon trigger:
 - vii. file upload via FTP and e-mail
 - viii. notification via e-mail
 - ix. record to local storage (SD/SDHC/SDXC card)
 - x. external output
 - d. Pixel Counter available in the plug-in web viewer.
7. Provide Trendnet TI-IG60 and proper power supply with each C3 camera installed.
- a. Manufacturer and model:
 - i. Panasonic WV-S8530N
 - ii. Or Approved Equal

2.04 ETHERNET WITH POWER OVER ETHERNET (POE) UTP SURGE SUPPRESSOR

- A. When mounted in interior spaces:
- 1. Shielded RJ-45 jacks and ground stud
 - Connect ground stud directly to ground bar (TMGB/TGB) or ground.
 - 2. Do not use shielded cable on the output.
 - 3. Maximum supported data rate: 1000Mb/s
 - 4. (Gigabit)
 - 5. Supports IEEE 802.3af (PoE)
 - 6. Turn on Voltage: 150V L-L,
 - 7. L-G RoHS compliant
 - 8. UL 497B listed
 - 9. Meets Telecordia GR-1089
 - 10. Manufacturer:
 - a. DITEK DTK-MRJPOE
 - b. Or approved equal

2.05 FIBER OPTIC UNMANAGED SWITCH

- A. The contractor shall provide fiber optic unmanaged switch at each NEMA enclosure installed outdoors that feeds network connected devices.
- B. 4 port, hardened
 - 1. 10/100/1000
 - 2. Ethernet
 - Operating temperature of -40 - 75 degrees C
 - 3. External AC power
 - supply 4. Manufacturer:
 - a. Transition Networks SISTG1040-242-LRT with Proper Single-Mode GBIC

2.06 COAXIAL MEDIA CONVERTER

- A. The contractor shall provide Ethernet with PoE over coaxial cable media converters at each elevator containing a security camera.
- B. Single port, interior, PoE output
 - 1. 10/100/1000 Ethernet
 - 2. Operating temperature of -40 - 75 degrees C
 - 3. External AC power
 - supply 4. Manufacturer:
 - a. Transition Networks EOCPSE4020-110 & EOCPD4020-110

2.07 NEMA ENCLOSURE

- A. Contractor shall provide a 24x24x10 NEMA 4 enclosure at the base of every exterior pole that has a mounted network connected device.
- B. NEMA enclosure shall be properly secured to the pole using proper fasteners and support. Coordinate mounting and electrical receptacle requirements with Div 26 contractor.
- C. Contractor shall coordinate with SCC contractor for network infrastructure.
- D. Refer to security details for enclosure layout.
- E. Provide with interior mounting panel
- F. A24P24G Manufacturer
 - 1. Hoffman A24H24BLP

PART 3 EXECUTION

3.01 TESTING

- A. Refer to Section 27 00 00 for additional requirements. (Need to add specific requirements for this section.)
- B. Prior to energizing or testing the system, ensure the following:
 - 1. All products are installed in a proper and safe manner per the manufacturer's instructions.
 - 2. Dust, debris, solder, splatter, etc., is removed.
 - 3. Cable is dressed, routed, and labeled; connections are consistent with regard to polarity.
 - 4. All products are neat, clean, and unmarred, and parts are securely attached.
- C. Contractor shall ensure that each device in the security system is functioning normally and in such a manner as to meet the functional and performance requirements in this specification.

3.02 TRAINING

- A. Refer to Section 27 00 00 for additional requirements. (Need to add specific requirements for this section.)
- B. Provide system operations, administration, and maintenance training by factory-trained personnel qualified to instruct.
 - Contractor shall provide up to 12 hours of scheduled and dedicated training time in three
 - 1. (3) four (4) hour sessions for administration and investigation.
 - 2. Contractor shall provide up to 2 hours of scheduled and dedicated training time for maintenance including lens and dome cleaning, focusing and positioning.
 - 3. Provide printed training materials for each trainee, including product manuals, course outline, workbook or student guides, and written examinations for certification.
 - Provide hands-on training with operational equipment.
 - 4. Training shall be oriented to the specific system being installed under this contract as designed and specified.
 - 5. Contractor shall provide all necessary documentation of system operating parameters prior to scheduled training sessions.
 - 6.

3.03 WARRANTY

- A. Refer to Section 27 00 00 for additional requirements.

3.04 INSTALLATION PRACTICES

- A. All services provided shall be professional and conform to the highest standards for industry practices. The Owner reserves the right to halt any installation due to poor workmanship. All work shall be defect free, and the installer shall replace, at their expense, any work found to be defective.
The Owner reserves the right to halt any installation due to failure of Contractor to observe
- B. installation-free periods due to instructional or administrative requirements. To the m

aximum extent possible, the Owner will provide advance notice of such periods.

- C. Contractor is responsible for providing a complete and functional video surveillance system.
- D. All manufactured items, materials, and equipment shall be applied, installed, connected, erected, used, and adjusted as recommended by the manufacturers, or as indicated in their published literature, unless specifically noted herein to the contrary.
- E. Contractor shall follow these standards and approved submittals for locations of power supplies. The Owner intends to limit the number and location of power supplies to facilitate more effective long-term support and maintenance of the system.

3.05 COORDINATION

- A. Contractor shall provide up to 8 hours (up to four, 2-hour sessions) of scheduled and dedicated coordination time to assist Owner with camera positioning and coordination as requested by Owner or Consultant.

3.06 AESTHETICS

- A. All cables and equipment terminating at panels frames shall be vertically straight, with no cables crossing each other, from twelve inches inside the ceiling area to the termination block.
All cable bundles shall be combed and bundled to accommodate individual termination block rows and panels.
- B. For any given telecom room, a horizontal and vertical alignment for all mounting hardware will be maintained to provide a symmetrical and uniform appearance to the distribution frame.
- C. All surface-mounted devices shall be firmly secured level and
- D. plumb All rack mount equipment shall be securely installed.

3.07 HARDWARE LAYOUT

- A. Hardware positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

3.08 VMS INSTALLATION PRACTICES

- A. Verify that the manufacturer approved server hardware, OS meets the Owner's IT standards prior to ordering.
- B. Coordinate server power, cooling, and mounting requirements with Owner prior to installation.
- C. Coordinate virus scan/security software requirements with Owner and manufacturer prior to installation.

3.09 DEVICE CABLING/WIRING INSTALLATION PRACTICES

- A. All external wire and cables shall be supported at least every five feet from the structure or as required to maintain not more than 12" cable sag between supports and without over tensioning the cables. Provide j-hooks as needed where cable tray or raceway is not available. This Contractor shall coordinate installation with Division 27 05 00 cabling Contractor to ensure
- B. there is at least 2-inches of physical separation between security cabling and voice/data cabling throughout cable path. Voice/data cabling Contractor has first claim to cable tray.
- C. All cables, regardless of length, shall be labeled within 18" of both ends with an identifier that is keyed to the door, room, or corridor number as identified.
- D. All cables shall have 6-foot service loops neatly coiled in the equipment room. During initial cable rough-in, this Contractor shall have sufficient slack to route anywhere within the equipment room.
- E. Cabling shall be adequately supported with Velcro wire wraps and horizontal support cable managers fastened to rack frame. Cables shall be dressed in a neat and orderly fashion. Any cabling or equipment installation that is deemed unacceptable by the Owner or Consultant shall be replaced or corrected by the Contractor at no additional cost. Plastic zip ties are not allowed.
- F. All cables are to run at right angles to the structure, placed above the ceiling in halls or corridors.
- G. Cables shall not run above red iron joist.
- H. Contractor shall make every effort to conceal wiring and other apparatus into walls, floors, and ceilings, assuming code and good engineering practice allows and suggests.
- I. Ties and straps shall be installed snugly without deforming cable insulation. Ties shall be spaced at uneven intervals not to exceed four feet. No sharp burrs shall remain where excess length of the cable tie has been cut.
- J. Contractor shall notify Owner immediately if obstruction or hazard is discovered in a pathway provided by others.
Cable shall be stored and handled to assure that it is not stretched, kinked, crushed, or
- K. abraded in any way. Bend radiuses shall meet manufacturer specifications and/or recommendations. Cable shall not be installed in ambient temperatures or moisture conditions above or below the manufacturer's rating.
- L. No splices shall be installed in any cable.

3.10 CABLE TERMINATION

- A. Termination hardware (blocks and patch panels) positioning and layout shall be reviewed and approved by the Owner prior to construction. The review does not exempt Contractor from meeting any of the requirements stated in this document.

3.11 INTEGRATION WITH PHYSICAL SECURITY SYSTEMS AND INTERCOM/PA SYSTEM

- A. The video surveillance system shall be integrated with the Physical Security Systems and Intercom/PA system via an Ethernet interface with the minimum follow features.
 - 1. Graphical floor plan maps showing icons of all cameras, intercoms and other integrated systems.
 - 2. Camera views associated with intercom stations and doors.
 - 3. Camera views linked to other camera views for seamless tracking of a subject throughout a facility.
 - 4. Device names brought in from the integrated systems.
 - 5. Database entries for all actions performed.
 - 6. Time syncing via common NTP server.
 - 7. Microsoft Active Directory integration.
 - 8. Microsoft Exchange integration for email notifications.
 - 9. Intercom audio recorded to VMS server synchronized with the associated camera.
- B. The Contractor shall provide any and all licensing to integrate the systems together including any additional items to be added to the yearly maintenance agreement.
- C. Refer to the individual specification sections for additional specific integration requirements.
- D. The Contractor shall set up a meeting between the Owner, Consultant and manufacturer to determine the exact functionality of the integration before the integration starts.

3.12 FIRE STOPPING

- A. Fire stopping of openings between floors, fire-rated walls, and smoke-rated walls, created by others for This Contractor to pass cable through, shall be the responsibility of the This Contractor. Sealing material and application of this material shall be accomplished in such a manner that is acceptable to the local fire and building authorities having jurisdiction over this work.
- B. Any openings created by or for This Contractor and left unused shall be sealed up by This Contractor.
- C. This Contractor shall be responsible for creating a waterproof seal in and around any openings that This Contractor creates from the structure to the outside environment.

3.13 SYSTEM INSPECTION

- A. Contractor shall coordinate with project representative for inspection after Contractor has completed testing of entire system.
- B. Contractor shall have trained Contractor representative and testing equipment on site during i

- inspection to assist with spot verification of tests.
- C. Contactor shall verify with Project Representative the precise positioning of camera aim and shall make fine adjustments as requested.

3.14 LABELING

- A. Contractor shall neatly label all security devices and cabling at both ends. All labels shall be on Project as-built drawings.

3.15 CAMERA INSTALLATION

- A. Contractor shall field verify all camera locations and positioning with Owner prior to installation.

3.16 CAMERA AIMING AND ACCEPTANCE

- A. The Contractor shall provide an initial aim, zoom, field of view adjustment, rotation and focus immediately after the camera is installed following the design intent on the drawings and camera schedule.
The Contractor shall then take screen shots from the camera's web interface, label them
- B. based on the drawings device number and present them to Owner and Consultant for an initial review and comment. The Contractor shall furnish a battery powered PoE injector to power up the camera to provide the initial aim/focus and screen shots and shall not rely on the Owner network or PoE switches to be online or available.
- C. The Contractor shall then adjust cameras aim and field of view based on Alamo College and/or Consultant's feedback and update the screen shots.
- D. After the cameras aim, zoom, field of view adjustment and focus are finalized, the Contractor shall submit the screen shots to Owner to obtain their final sign-off or comments. If any comments are received, the Contractor shall make the adjustments necessary and take updated screen shots and submit for re-approval.
- E. The above will not happen at the same time and the Contractor shall plan on multiple trips to the project to make the adjustments.
- F. The Contractor shall include the final screen shots as part of the as-builts.

3.17 DOCUMENTATION

- A. Upon completion of the installation, Contractor shall provide full documentation sets to the Consultant for approval as described in section 27 60 00. All documentation shall become the property of the Owner.
- B. Documentation shall include the additional specific items detailed in the subsections below: Contractor shall provide hard copy and electronic forms of the final test results.
 - 1.
 2. Contractor shall provide a document including the following:

- a. Camera label/identifier
- b. Location of each drop by orientation/permanent landmark in the room
- c. Contractor shall provide accurate as-built Construction Drawings. The drawings are to include cable routes and device locations.

3.18 PRE-CHECKOUT

- A. The Contractor shall demonstrate the following to Owner during system demonstration.
 1. The cameras are fully installed and functional.
 2. Camera adjustments are complete to the Owner's satisfaction including.
 - a. Aim/Zoom
 - b. Focus/Back Focus
 - c. Dehumidification
 - d. Masking Zones
 - e. Motion Detection Zones
 - f. Pre-Sets/Tours

3.19 FINAL ACCEPTANCE

- A. In addition to closeout requirements in section 27 60 00, This Contractor shall demonstrate the following before final approval.
 - Owner training is complete.
 1. Punch list items are
 2. complete.
 3. As-built documentation is complete and submitted to Owner/Consultant.

3.20 ANNUAL SUPPORT AGREEMENT

- A. An annual support agreement (after the 1st year full of support/warranty) shall not be part of the bid. The Contractor shall work directly with the Owner at the end of the project to determine the ongoing hardware/software support. The Contractor shall send the Consultant a copy of the support agreement for review prior to finalization.

3.21 FINAL PROCEDURES

- A. Perform final procedures in accordance with section 27 60 00.

END OF SECTION

SECTION 28 31 00 – FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED WORK

- A. 26 05 00 – Grounding and Bonding
- B. 26 05 29 – Electrical Hangers and Supports
- C. 26 05 33 – Raceway and Boxes

1.3 DESCRIPTION

- A. This section of the specifications includes the furnishing, installation, connection and testing of microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, coordinated networked system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Voice Evacuation Fire Alarm Control Panel (FACP), Voice Evacuation devices, auxiliary control devices, annunciators, Ethernet and/or digital alarm communications to central stations and wiring as shown on the drawings, specified herein, and per the manufacturer's requirements.
- B. The fire alarm system shall comply with requirements of NFPA Standard No. 72 for Local Protected Premises Signaling Systems except as modified and supplemented by this specification. The system field wiring shall be supervised either electrically or by software-directed polling of field devices.
 - 1. The Secondary Power Source of the fire alarm control panel will be capable of providing at least 24 hours of backup power with the ability to sustain 5 minutes in alarm at the end of the backup period.
- C. The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.
- D. The FACP and peripheral devices shall be manufactured or supplied 100% by a single U.S. manufacturer (or division thereof).
- E. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final check-out and to ensure the systems integrity.
- F. The FACP shall meet requirements of UL ANSI 864 Ninth Edition

1.4 SCOPE

- A. An intelligent, microprocessor-controlled, fire alarm detection system shall be designed, furnished, and installed in accordance to the project specifications and drawings.
- B. Contractor shall provide a new FACP **with voice evacuation**. Provide voice evacuation speakers in locations in order to provide code required dB levels during an alarm event.
- C. All devices shall be fully addressable utilizing all final room graphic names and numbers.
- D. Any devices installed in high ceiling areas shall have programming reference on device that can be read from floor level.

- E. Contractor shall connect all back-up batteries per manufacturer's instructions.
- F. Basic Performance:
 - 1. Initiation Device Circuits (IDC) shall be wired Class B (NFPA Style B) as part of an addressable device connected by the SLC Circuit.
 - 2. Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y) as part of an addressable device connected by the SLC Circuit. Cable shall be Belden 6341PC 18 AWG 2 Pair, CMP Plenum Cable, Individually Shielded or equivalent.
 - 3. All circuits shall be power-limited, per UL864 requirements.
 - 4. A single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
 - 5. Alarm signals arriving at the main FACP shall not be lost following a primary power failure or outage of any kind until the alarm signal is processed and recorded.
- G. Basic System Functional Operation
When a fire alarm condition is detected and reported by one of the system's initiating devices, the following functions shall immediately occur:
 - 1. The system Alarm LED on the FACP shall flash.
 - 2. A local sounder with the control panel shall sound.
 - 3. A backlit 80-character LCD display on the FACP shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
 - 4. In response to a fire alarm condition, the system will process all control programming and activate all system outputs (alarm notification appliances and/or relays) associated with the point(s) in alarm. Additionally, the system shall send events to a central alarm supervising station via either dial-up over PSTN or Internet or Intranet via PSDN or virtual private network.
 - 5. If there are any discrepancies between the drawings and specification or among themselves, the contractor shall request clarification prior to providing pricing for the scope of work. If a request is not issued and a response not provided via a posted addendum, the contractor shall provide pricing for the most costly scenario and obtain clarification during the course of the project.

1.5 GENERAL REQUIREMENTS

- A. All fire alarm system designs shall meet local, state and municipal codes.
- B. Main fire alarm control panel to be located in building technology headend room (MDF). Do not install in mechanical or electrical rooms.
- C. Local annunciator panel with microphone to be located in front administration area.
- D. Do not install panel battery cabinet above ceiling. Shall be installed at standard height for servicing without ladder.

- E. Review location of all fire alarm pull stations with owner prior to final design submission to AHJ.
- F. Provide all cabling and devices to integrate with the First Responder Antenna System (FRAS / ERRC-BDA) on all projects.
- G. Provide switch bank allowing end user to enable and disable service groups.
- H. Fire alarm system shall be able to be tested during school hours. Coordinate with Maintenance and Police Department for any system tests.
- I. Fire alarm contractor responsible for adding points for FRAS / ERRC-BDA system.
- J. Provide protective covers on all fire alarm devices installed in gyms.
- K. System shall conform to NFPA 72 and NFPA 101

1.6 CODES AND STANDARDS

- A. The system shall comply with the applicable Codes and Standards as follows:
 - 1. National electric Code Article 760
 - 2. UL1971 Visual Signaling Appliances
 - 3. ANSI 117.1 Visual Devices
- B. National Fire Protection Association Standards:
 - No. 13 Sprinkler Systems
 - No. 70 National Electric Code (NEC)
 - No. 72 National Fire Alarm Code
 - No. 101 Life Safety Code
 - No. 38 Manually Actuated Signaling Boxes
 - No. 217 Smoke Detectors, Single and Multiple Stations
 - No. 228 Door Closers–Holders for Fire Protective Signaling Systems
 - No. 268 Smoke Detectors for Fire Protective Signaling Systems
 - No. 268A Smoke Detectors for Duct Applications
 - No. 346 Waterflow Indicators for Fire Protective Signaling Systems
 - No. 464 Audible Signaling Appliances
 - No. 521 Heat Detectors for Fire Protective Signaling Systems
 - No. 864 Control Units for Fire Protective Signaling Systems
 - No. 1481 Power Supplies for Fire Protective Signaling Systems
 - No. 1610 Central Station Burglar Alarm Units
 - No. 1638 Visual Signaling Appliances
 - No. 1971 Visual Signaling Appliances
 - No. 2017 General-Purpose Signaling Devices and Systems
- C. Local & State Building Codes
- D. Requirements of Local Authorities having Jurisdiction
- E. Underwriters Laboratories Inc. (UL) - USA:
 - No. 38 Manually Actuated Signaling Boxes
 - No. 50 Cabinets and Boxes
 - No. 864 Control Units for Fire Protective Signaling Systems

- No. 268 Smoke Detectors for Fire Protective Signaling Systems
- No. 268A Smoke Detectors for Duct Applications
- No. 346 Waterflow Indicators for Fire Protective Signaling Systems
- No. 464 Audible Signaling Appliances
- No. 521 Heat Detectors for Fire Protective Signaling Systems
- No. 1971 Visual Notification Appliances

CAN/ULC S524-01 Standard for Installation of Fire Alarm Systems

- 1. The FACP shall be ANSI 864, 9th Edition Listed. Systems listed to ANSI 864, 8th edition (or previous revisions) shall not be accepted.

- F. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.
- G. All requirements of the Authority Having Jurisdiction (AHJ).
- H. American's with Disabilities Act (ADA)

1.7 SYSTEM DESCRIPTION

- A. Multiprocessor-Based:
 - 1. The system shall be of multiprocessor design to allow maximum flexibility of capabilities and operation.
- B. Field Programmable:
 - 1. The system shall be capable of being front-panel programmed or by Field Configuration Program (FCP) allowing programming to be downloaded via computer from any node on the network.
- C. RS-232C Serial Output:
 - 1. A supervised RS-232C serial port shall be provided to operate remote printers and/or video terminals, accept downloaded program from the computer, or provide an 80-column readout of alarms, troubles, location descriptions, time, and date.
 - 2. Communication shall be via standard ASCII code operating at a 9600-baud rate.
- D. Control-by-Event (CBE) Program:
 - 1. Operation of a manual station or automatic activation of any smoke sensor, heat sensor, or waterflow device shall activate system control-by-event program to cause:
 - a. All notification appliances to sound in continuous pattern and strobes to flash.
 - b. Shut down all air-handling units as specified herein.
 - c. "SYSTEM ALARM" LED shall flash and panel sounder shall pulse.
 - d. Indicate on the 80-character alphanumeric panel display a description of the specific analog/addressable device in alarm. The display shall be of the liquid crystal type (LCD), clearly visible in the dark or in poor light conditions.
 - e. Close all magnetically held doors automatically.
 - f. Energize programmed solenoids for activating sprinkler or extinguishing

- g. systems.
 - g. Perform additional function as specified herein or as indicated on the Drawings.
 - h. Notify the Fire Department.
- E. General System Operation:
- 1. When an alarm occurs, the control panel as well as any other control panel in the same region, or any control panel programmed as a global annunciator shall indicate an alarm condition until manually reset.
 - 2. The alarm may be acknowledged by pressing the "ALARM ACKNOWLEDGE" switch.
 - 3. This shall silence the panel sounder and change the "ALARM" LED from flashing to steadily lit.
 - 4. All notification appliances may be silenced by operating the "SIGNAL SILENCE" switch on any panel in the same region or from any panel programmed as a global annunciator.
 - 5. This shall steadily light the "SYSTEM SILENCED" LED.
 - 6. If a subsequent alarm is activated, notification appliances shall "resound" until again silenced.
 - 7. Once silenced, all notification appliances may be restored by operating the "SIGNAL SILENCE" switch.
 - 8. Waterflow zones shall be non-silenceable.
- F. Alarm Verification:
- 1. Smoke sensor alarm verification shall be a standard option, while allowing any dry contact device, such as manual stations and heat detectors, to create an immediate alarm.
 - 2. This feature shall allow smoke sensors that are installed in environments prone to nuisance or unwanted alarms to operate according to following sequence:
 - a. Smoke Sensor Alarm: At time = 0.
 - b. Pre-alarm Window: 15 seconds. A distinctive pre-alarm indication shall be displayed.
 - c. Reset: 5 seconds. Occurs at end of pre-alarm window.
 - d. Alarm Verification Window: 90 seconds. The system shall respond to a second alarm from the same smoke sensor as the system alarm.
 - e. System Ready: No alarm verification.
 - f. The verification sequence is suspended once the system alarm is activated.
- G. Alarm Signals:
- 1. All alarm signals shall be automatically latched or "locked in" at the control panel until the operated device is returned to normal and the control panel is manually reset.
 - 2. When used for waterflow, the "SIGNAL SILENCE" switch shall be bypassed.
- H. Electrically Supervised:
- 1. Each signaling line circuit and notification appliance circuit shall be electrically

- supervised for opens, shorts, and ground faults.
 2. Occurrence of a fault shall activate system trouble circuitry, but shall not interfere with proper operation of a circuit that does not have a fault condition.
 3. The yellow "SYSTEM TROUBLE" LED shall light and the system audible sounder shall steadily sound when trouble is detected in the system. Failure of power, opens, or short circuits on notification appliance or signaling line circuits, disarrangement in system wiring, failure of microprocessor or identification module, or system ground faults shall activate this trouble circuit.
 4. The trouble signal may be acknowledged by operating the "ALARM ACKNOWLEDGE" switch. This shall silence the sounder. If subsequent trouble conditions occur, trouble circuitry shall resound.
 5. During alarm, all trouble signals shall be suppressed with exception of lighting the yellow "SYSTEM TROUBLE" LED.
- I. Drift Compensation, Analog Smoke Sensors:
1. System software shall automatically adjust each analog smoke sensor approximately once each week for changes in sensitivity due to effects of component aging or environment (i.e.: dust).
 2. Each sensor shall maintain its actual sensitivity under adverse conditions to respond to actual alarm conditions, while ignoring factors that generally contribute to nuisance alarms.
 3. System trouble circuitry shall activate, display "DIRTY DETECTOR" and "VERY DIRTY DETECTOR" indications and identify the individual unit that has been compensated beyond its acceptable limits.
- J. Analog Smoke Sensor Test:
1. System software shall automatically test each analog smoke sensor a minimum of 3 times daily.
 2. Test shall be a recognized functional test of each ionization chamber (analog ionization sensors) and photocell (analog photoelectronic sensors) as required annually by NFPA 72.
 3. Failure of a sensor shall activate system trouble circuitry, display a "Test Failed" indication, and identify the individual unit.
- K. Dual-Mode Walk Test:
1. The control unit shall provide a Dual-Mode Zoned Walk Test Program that shall enable an individual to test the Alarm/Supervision status of each sensor or module connected to system.
 2. During walk test, the control unit shall automatically reset after an alarm condition enabling the technician to continue testing the system without requiring a return to control panel.
 3. During an Audible walk test, placing a device in alarm shall cause 4 pulses on the notification appliance circuits. Operation of a supervisory switch shall cause 3 pulses, while removal or disconnection of an initiating device shall cause 2 pulses. All tests shall be recorded by the printer for reference.
 4. The silent walk test shall record all tests by printer for reference, while not activating notification appliance circuit(s).

- L. Printed Circuit Boards, Control Panel Components:
 - 1. The control unit shall be housed in a steel cabinet.
 - 2. All groups of circuits or common equipment shall be clearly marked.
 - 3. The control unit shall be red in color and shall include the following features:
 - a. A solid-state power transfer circuit that shall switch to standby power automatically and instantaneously if normal power fails or falls below 15 percent of normal ("brown out" conditions). This circuit shall allow batteries to be effectively "floated" on the operating system to avoid upsetting normal microprocessor operation and minimize resultant nuisance troubles and/or alarms. This circuit shall be physically isolated from the power supply to facilitate service.
 - b. Ground fault detector to detect positive or negative grounds on signaling line circuits, notification appliance circuits, and power circuits. Ground fault indication shall occur on display and general trouble devices shall operate as specified herein, but shall not cause alarm.
 - c. Lightning protection shall be a standard feature of the fire alarm control panel and shall be incorporated in the power supply circuit, common control circuits, and notification appliance circuits. Systems that require an optional module to provide this protection shall not be considered equal.
 - d. Individual overcurrent protection shall be provided for the following: smoke detector (resettable) power, main power supply, battery standby power, and auxiliary (non-resettable) output.
 - e. Common reset and lamp test switch, labeled "SYSTEM RESET/LAMP TEST" shall be provided on panel.
- M. City Connection:
 - 1. The fire alarm system shall be connected via Digital Alarm Communicator Transmitter (DACT) over telephone lines to a central station or remote station.
 - 2. The fire alarm system shall be equipped with a Cellular Dialer to connect to a central station or remote station.
 - 3. The panel shall contain a disconnect switch to allow testing of the system without notifying the fire department.
- N. Remote Station Option:
 - 1. The fire department shall be consulted as to the authorized remote station serving the municipality.
 - 2. The fire alarm system shall transmit both alarm and trouble signals with the alarm having priority over the trouble signal.
 - 3. The contractor shall be responsible for installation charges, while the owner shall be responsible for line lease charges.
- O. Central Station Option:

1. The fire alarm control panel shall provide an integral Digital Alarm Communicator Transmitter (DACT) for signaling to a Central Station. The DACT shall contain a "Dialer-Runaway" feature preventing unnecessary transmissions as the result of intermittent faults in the system and shall be Carrier Access Code (CAC) compliant, accepting up to 20-digit central station telephone numbers.
2. The fire department shall be consulted as to the authorized central station companies serving the municipality.
3. The fire alarm system shall transmit both alarm and trouble signals with the alarm having priority over the trouble signal.
4. The contractor shall be responsible for installation charges, while the owner shall be responsible for line lease charges.

1.8 CONTRACTOR QUALIFICATIONS

- A. The installing contractor shall be the authorized representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the fire alarm manufacturer's product for at least three years.
- B. The installing contractor shall be licensed by the State Fire Marshall to sell, install, and service fire alarm systems as required by Article 5.43-2 of the Texas Insurance Code.
- C. The installing contractor shall have on his staff an installation technician licensed by the State Fire Marshall's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the Texas Insurance Code.
- D. The installing contractor or equipment supplier shall have on staff a minimum of two (2) certified NICET Level III state licensed fire alarm planning superintendents under whose supervision system design shall take place. In lieu of an alarm planning superintendent, the contractor may provide design supervision by a registered professional engineer.
- E. The installing contractor shall provide 24 hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- F. The installing contractor must have a permanent office within a 100 mile radius of the project site and be an approved dealer/integrator, of the proposed system, in the nearest major metropolitan area.
- G. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems in the surrounding area for at least ten (10) years.
- H. All individuals installing the fire alarm system must be employees of the certified installer and at least 25% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.
- I. The proposing contractor and the installing contractor must be the same company. No subcontractor to the proposing fire alarm system contractor will be allowed for any portion of the fire alarm system scope of work.
- J. Acceptable manufacturers:
 1. The system specified shall be that of Simplex.

2. No other manufacturers shall be accepted.

1.9 ACCEPTABLE MANUFACTURER

- A. All fire alarm system devices and equipment shall be manufactured by Simplex. No other manufacturers will be accepted.
- B. All equipment, materials, accessories, devices, etc. covered by the specifications and/or noted on the contract drawings shall be new and unused and be U.L. listed for their intended use.
- C. All equipment provided shall be available for purchase from at least two authorized distributors within the service area.

1.10 SUBMITTALS

- A. The installing contractor and/or equipment supplier shall provide complete and detailed shop drawings and include:
 - 1. Control panel wiring and interconnection schematics.
 - 2. Complete point to point wiring diagrams.
 - 3. Complete floor plan drawings locating all system devices.
 - 4. Factory data sheets on each piece of equipment proposed.
 - 5. Detailed system operational description.
 - 6. Complete system bill of material.
 - 7. Location of wall penetrations (all penetrations shall be sleeved and contain protective bushings at both ends)
 - 8. Location of sleeved wall pass-thru
 - 9. Size of sleeve at each location installed
 - 10. Quantity of cable passing through each sleeve
- B. All submittal data will be in bound form with contractor's name, supplier's name, project name, and state fire alarm license number adequately identified.
- C. Only basic equipment devices have been shown on the contract drawings. Specific wiring between equipment/devices may not be shown. It is the contractor's responsibility to submit for approval the COMPLETE ENGINEERED system configuration and layout showing all devices, wiring, conduit, and locations along with other required information as specified herein to provide a complete operational system as specified.
- D. Specification Compliance: A letter shall be provided stating, by section and subsection, that the fire alarm system installer complies with the ENTIRE specification section. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
- E. Drawing Compliance: A letter shall be provided stating that the fire alarm system installer complies with the ENTIRE project drawing, including all general, keyed, and notes to contractor. If the installer intends to deviate from any portion of the specifications, a detailed explanation of reason in which the installer would like to deviate shall be provided in addition to the specification compliance letter. NO DEVIATIONS SHALL BE ACCEPTABLE UNTIL THEY HAVE BEEN ACCEPTED BY THE PROJECT'S TECHNOLOGY CONSULTANT.
- F. Certifications/Licensing: The contractor shall submit all of the following certifications/licensing and the all must contain dates which are valid from the date of proposal and not expirer any sooner than 12 months after substantial completion of the project.

1. State Fire Alarm License
 2. Manufacturer's Authorized Dealer Certification
 3. NICET Level III certification (1 for each required)
 4. Manufacture Installer Training Certificate (required for at least 25% of all installers on site.)
- G. Fire Alarm Close Out requirements
- a. Service and maintain fire alarm system for one year from the date of project substantial completion. Clean and adjust equipment as per manufacturer recommendations. Provide scheduled maintenance tasks to keep system warranty in effect.
 - b. Provide documentation of all preventive maintenance and service calls.
 - c. Provide training to personnel at completion of project.
 - d. Provide fire alarm close out documents and fire alarm panel programming to Life Safety Dept.
 - e. Provide backup copy of panel programming to Maintenance.
 - f. Perform annual test (NFPA 72 Fig 7-5.2.2 testing and inspection form) during final month of warranty period to certify complete operating system.
 - g. Provide one (1) Allen resetting wrench or key per pull station installed.
 - h. Provide six (6) keys of each type of device.
 - i. Provide three (3) detectors of each type installed on project for attic stock.
- 1.11 DELIVERY, STORAGE, AND HANDLING**
- A. Delivery: Deliver materials to the site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
 - B. Storage: Store materials in a clean, dry area indoors in accordance with the manufacturer's instructions.
 - C. Handling: Protect materials from damage during handling and installation.
- 1.12 INTERFACING**
- A. Coordinate the Work of this section with the Work of other sections for purpose of interfacing to building systems as required on the Drawings, including but not limited to, elevator interface, HVAC interface, and security system interface.
- 1.13 COORDINATION**
- A. It shall be the responsibility of the installing contractor to coordinate all requirements surrounding installation of the fire alarm system with **ALL** other trades.

PART 2- PRODUCTS

2.1 MANUFACTURER

- A. The specified and approved equipment manufacturer is Simplex
- B. All Fire Alarm Systems shall be manufactured one manufacturer.
- C. The district reserves the right to reject or deny the use of any product or service provider if they do not meet our standards for product or installation methods. We also reserve the right to reject any installer based on past performance in the district or with other school districts in the nearest, major metropolitan area.
- D. The Following Panels will be used for this project's applications.
 - 1. Simplex, voice evacuation system.

2.2 GENERAL

- A. All equipment furnished for this project shall be new and unused. All equipment, materials, accessories, devices, and other facilities covered by this specification or noted on contract drawings and installation specifications shall be the best suited for the intended use and shall be the product of a single manufacturer.

2.3 SYSTEM OVERVIEW:

- A. The Fire Alarm / Life Safety System shall be a microprocessor-based system designed specifically for smoke and fire detection applications. The Fire Alarm / Life Safety System shall be UL listed under Standards 864 (*Control Units for Fire-Protective Signaling Systems*) under category UOJZ.

2.4 PANEL COMPONENTS AND FUNCTIONS

- A. General
 - 1. The control panel shall be a multi-processor based system designed specifically for fire and releasing system applications. The control panel shall be listed and approved for the application standard(s) as listed under the General section.
 - 2. The control panel shall include all required hardware, software and system programming to provide a complete and operational system. The control panel shall assure that life safety takes precedence among all panel activities.
 - 3. The control panel shall include the following capacities:
 - a. Support up to 1000 analog/addressable points plus 48 conventional circuits.
 - b. Support up to 8 fully supervised remote annunciators.
 - c. Support digital dialer (DACT) with multiple communication protocols
 - d. Support up to 1000 chronological events.
 - 4. The control panel shall include the following features:
 - a. Provide electronic addressing of analog/addressable devices.
 - b. Provide an operator interface display that shall include functions required to annunciate, command and control system functions.
 - c. Provide an internal audible signal with different programmable patters to distinguish between alarm, supervisory, trouble and monitor conditions.
 - d. Provide a discreet system control switch provided for reset, alarm silence, panel silence, drill switch, up/down/right/left switches, status switch and help switch.
 - e. Provide system reports.

- f. Provide an authorized operator with the ability to operate or modify system functions like system time, date, passwords, holiday dates, restart the system and clear control panel event history file.
 - g. Provide an authorized operator to perform test functions within the installed system.
 - h. All system programming and history shall be permanently stored in non-volatile memory to ensure that no programming or history is lost. Systems which store initial programming or field programming changes in battery backed memory will not be accepted.
5. Supervision of system components, wiring, initiating devices and software shall be provided by the control panel. Failure or fault of system component or wiring shall be indicated by type and location on the LCD display.
 6. Software and processor operation shall be independently monitored for failure. The system shall provide fail-safe operation, with a backup level of system operation.
 7. A compare utility shall identify programming and device changes on the system.
- B. Operators' Interface:
1. A Liquid Crystal Display (LCD) shall provide the means to inform the system operator with detailed information about the off-normal status of the installed Fire Alarm / Life Safety System. The LCD shall automatically respond to the status of the system, and shall display that status in 224-character front panel display.
 2. The following status functions shall be annunciated by the LCD Display:
 - a. When the Fire Alarm / Life Safety System is in the "Normal" Mode, the panel shall display: current date and time, a two-line custom system title, and a summary total of system events.
 - b. With the Fire Alarm / Life Safety System is in the off-normal mode, the LCD display shall automatically reconfigure into three logical areas.
 - c. Panel Status Area - The LCD shall show the system time, the number of active points, and disabled points in the system.
 - d. Event Area - The LCD shall show the first two active events of the highest priority
 - e. Type Status Area - The LCD shall show the total number of active events in the system, by the following event types: "Alarm Events", "Supervisory Events", "Active Trouble Events", and "Active Monitor Events".
- C. Addressable Device Controller:
1. A 100% digital loop controller shall be provided in the Fire Alarm / Life Safety System panel to interface with the intelligent microprocessor-based detectors and modules.
 2. It shall be possible to connect the loop controller to the detectors and modules using any wiring material or method complying with Chapter 3 of the National Electrical Code without the need for special shielding, twisted wire, or conduits. The loop controller shall be capable of supporting Class A (Style 7) or Class B (Style 4) circuits without the need for additional hardware modules. It shall be possible to wire multiple branch circuits (T-Taps) from Class B Circuits (Style 4).
 3. The loop controller shall be capable of setting the address of all Intelligent microprocessor-based devices connected to it electronically, without the need to set switches at any of the individual devices.
 4. The loop controller shall provide a minimum of 6 types of supervision for each smoke detector on the circuit:
 - a. Device location
 - b. Unexpected device add/Delete

- c. Missing device address
 - d. Changes in the physical wiring of the circuit
 - e. Changes in device settings
 - f. Device maintenance alert
5. The loop controller shall determine the electrical location of each connected detector and module. The location and type of each connected device shall be mapped and stored in memory in the loop controller. It shall be possible to access and display this map.
 6. It shall be possible to obtain a mapping report of all devices connected to the loop controller for confirmation of "as-built" wiring. The mapping report shall show the electrical relationship of all connected devices, including T-Taps, device types, and the panel addresses of devices on the circuit. The loop controller shall be capable of reporting any additional device addresses, which may have been added to the circuit, and/or changes that may have been made to the wiring in the data circuit. A specific trouble shall be reported for any and all off-normal non-alarm condition.
 7. The loop controller shall notify the system when any connected smoke detector reports a "routine maintenance required" signal to the system.
- D. Notification Appliance Circuits:
1. Provide as indicated on the plans, supervised hard-wired Notification Appliance Circuits (NAC) for the control of 24Vdc notification appliances. Each NAC shall operate as Class B (Style Y) power limited circuit.
 2. NAC's shall be capable of providing steady, 20bps, 120bps or temporal rate outputs.
 3. Provide Notification Appliance Circuits to accommodate all new and existing devices and/or circuits.
- E. Power Supply
1. Each system power supply shall be a minimum of 6 amps @ 24 vdc.
 2. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any alarm, trouble or operator acknowledgment signals.
 3. Each system power supply shall be annunciated individually as a shall annunciate as a trouble signal, identifying the inoperable power supply(ies).
 4. All standby batteries shall be continuously monitored by the system. Low battery and disconnection of battery power supply conditions shall immediately annunciate as a trouble signal, identifying the deficient batteries.
 5. All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.
- F. Dialer (Digital Alarm Communicator Transmitter – DACT)
1. The system shall provide an off premise communications module capable of transmitting system events to multiple primary and secondary central monitoring station monitoring station receivers.
 2. The system module shall provide multiple monitoring station receiver formats capable of transmitting up to 8 subscribers.
 3. The system shall be capable of transmitting point information via Contact ID or SIA 4/2 protocols.

4. The Dialer shall be capable of communications with an E24 monitoring company. Provide programming, verification and testing with owner's service using actual account number.
 5. The system shall be equipped with a Cellular Dialer for wireless cellular communications.
- G. System Reports
1. The system shall provide the operator with system reports that give detailed description of the status of system parameters for corrective action, or for preventative maintenance programs. The system shall provide these reports via the main LCD, and shall be capable of being printed on the system printer.
 2. The system shall provide a report that gives a sensitivity listing of all detectors that have less than 80% environmental compensation remaining. The system shall provide a report that provides a sensitivity (% Obscuration per foot) listing of any particular detector.
 3. The system shall provide a report that gives a listing of the sensitivity of all of the detectors on the system, or any given analog/addressable device circuit.
 4. The system shall provide a report that gives a chronological listing of up to the last 1000 system events.
 5. The system shall provide a listing of all of the firmware revision listings for all of the installed components in the system.

2.5 LIFE SAFETY SYSTEM PROGRAMMABLE OPERATIONS:

- A. The routing of all system annunciation and control parameters shall be configurable to any or all remote annunciators on the system manually, or automatically as a function of the time of day or date.
- B. The system printer, if required, shall be configurable to display any combination or all of the following functions: Alarm, Supervisory, Trouble, and Monitor events.
- C. Each remote annunciator connected to the panel shall be configurable to show the status of any combination or of Alarm, Supervisory, Trouble, Monitor functions pertaining to any point in the system.
- D. Each point in the system shall be labeled with up to a 36 character custom message.
- E. System shall have the capability to provide logical "Counting AND" Groups and "Matrix Groups. Each matrix group shall be programmable by radius and activation number.
- F. System shall have the ability to define Service Groups. A Service group shall consist of any addressable field device and shall not be defined or limited by the physical layout of the Fire Alarm / Life Safety System, or its application to the protected premises. The system shall include the ability to define an alternate set of device commands which may be used in combination with the system test command and service groups for the testing of the connected intelligent microprocessor based devices.
- G. The system shall include Time Control functions that have the ability to control any system output or system operational sequence as a function of the month, day of week, date, hour, minute, or holiday.
- H. The system shall support software defined Logical Zone Groups which may group any input from any initiating device circuit, in order to control a system output or function, or

initiate any system operational sequence. A device or IDC may be a member of one Zone.

- I. The system shall have the ability to download data from the intelligent devices to a PC while the system is on-line and operational in the protected premises. The downloaded data may then be analyzed in a diagnostic program supplied by the system manufacturer.
- J. All final panel programming shall be configured as per final room number designation as identified by actual building room numbers, not architectural room numbers listed on construction set. **It is the contractor's responsibility to acquire the correct building room numbers.**

2.6 FIELD MOUNTED SYSTEM COMPONENTS:

- A. Analytical Microprocessor-based Detectors - General:
 1. System shall use Analytical Microprocessor-based Detectors that are capable of full digital communications with the Fire Alarm / Life Safety System using both broadcast and polling communications protocols. Each detector shall be capable of performing independent advanced fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns, and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted nuisance alarms caused by environmental events. Signal patterns that are not typical of fires shall be eliminated by digital filters and shall not cause a system alarm condition. Devices not capable of combining different fire parameters or employing digital filters will not be acceptable.
 2. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector's memory. Detectors not capable of making independent alarm decisions are not acceptable.
 3. Each detector shall have a separate means of locally displaying system communication and detector alarm status. A different LED indication for alarm and trouble shall be provided (devices in which the LED does not flash in supervisory mode are not acceptable).
 4. Each detector shall be capable of identifying diagnostic codes to be used for system maintenance. All diagnostic codes shall be stored in the detector. Each smoke detector shall be capable of transmitting pre-alarm, alarm, and maintenance signals to the Fire Alarm Control Panel via the Loop Controller.
 5. Each detector microprocessor shall contain an environmental compensation algorithm, which identifies and sets ambient "Environmental Thresholds" continually and periodically. In this manner, the environmental impact of temperature, humidity, environmental contaminants as well as detector aging shall be automatically monitored and adjusted for. This process shall employ digital compensation techniques to adapt the detector to both long term and short term changes in the environment in which they are installed. The microprocessor shall monitor this environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the derived base line sensitivity that the detector has sensed in its environment. The base line sensitivity information shall be automatically and periodically updated and permanently stored in the detector.

6. Each detector shall be capable of automatic electronic addressing and/or custom addressing, without the use of DIP or rotary switches, and shall mount on a common base to allow the simple replacement of one detector type with another detector type. The addressing of the detectors shall not depend on the electrical position of the detector in the circuit.
 7. If devices require DIP or rotary switches for addressing, every device shall be physically removed and verified during final checkout with engineer to confirm devices are located and programmed correctly. All switch addressed devices and their bases must be labeled with engraved plastic labels to identify device address and intended location. Labels shall have a red background with white letters, letters shall be a minimum of 1/4" in height.
- B. Detectors - Photoelectric Smoke Detector, (Duct Detector Use)
1. Photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to detect visible particulates produced by combustion. The integral microprocessor shall dynamically examine values from the sensor and initiate a system alarm based on the analysis of data. Detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, aging and humidity. Information shall be stored in the detector's memory and shall be transferred to the electronic loop controller for retrieval using a laptop PC or the Intelligent Detector Program/Service Tool designed by the manufacturer specifically for the purpose.
 2. The fire alarm contractor is responsible for reviewing the mechanical drawings for locations of all ductwork to identify where duct smoke detectors are required to be installed.
 3. The alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5% smoke obscuration per foot. The photo detector shall be suitable for operation in the following environment:
 - a. Temperature: 32°F to 120°F (0°C to 49°C)
 - b. Humidity: 0-93% RH, non-condensing
 - c. Elevation: no limit
- C. Duct Detector Housing:
1. The Analytical Microprocessor-based photoelectric smoke detector shall be readily adaptable for use in air duct smoke detection applications, using a housing that mounts to the outside of the duct. When used for duct smoke detection, the smoke detectors will not forfeit any of the system functionality that they have when used as area smoke detectors.
 2. The duct smoke detection housing shall allow the detector to sample and compensate for, variations in duct air velocity between 300 and 4,000 feet per minute.
 3. Remote alarm LEDs and Remote Test Stations shall be supported by the duct smoke detector and provided where indicated.
 4. All detectors used in duct applications shall be located in accordance with NFPA 72 recommendations.
 5. Contractor shall be responsible for repairing the duct work in areas where new devices do not fit the existing locations.
- D. Detectors - Fixed Temperature/Rate of Rise Heat Detector
1. Heat Detector shall have a solid state heat sensor, and shall transmit an alarm at a fixed temperature of 135° F (57°C) or due to a temperature Rate of Rise of 15°F/minute (9°C/minute). The detector shall continually monitor the temperature

- of the air in its surroundings to minimize thermal lag to the time required to process an alarm.
2. The heat detector shall be rated for ceiling installation at 70 ft (21.3m) centers and be suitable for wall mount applications.
 3. Detectors - Fixed Temperature Heat Detector,
 4. Heat detector shall have a solid-state heat sensor, and shall transmit an alarm at a fixed temperature of 135° F (57°C). Detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm.
 5. Heat detector shall be rated for ceiling installation at 70 ft (21.3m) centers and be suitable for wall mount applications.
 6. Detectors - Mounting Bases
 7. Mounting base will not contain any electronics, shall support all Microprocessor-based Smoke detector types detailed in this specification, and have the following minimum requirements:
 - a. Removal of the respective detector shall not affect electronic loop communications with other detectors on that loop.
 - b. Field Wiring Connections shall be made to the room side of the base, so that wiring connections can be made or disconnected by the contractor without the need to remove the mounting base from the electrical box.
 - c. Bases will have the option of external LED operation, Relay base or data line isolator base.
 - d. Relay bases shall mount in a standard electrical box described above and provide Form "C" contacts rated at 1 amp @ 30VDC and listed for "pilot duty".

2.7 MICROPROCESSOR-BASED INTELLIGENT MODULES – GENERAL

- A. Fire Alarm / Life Safety System shall incorporate microprocessor-based addressable modules for the monitoring and control of system Input and Output functions over a 2 wire electronic communications loop, using both broadcast and serial polling protocols. All modules shall display communications and alarm status via LED indicators.
- B. The function of each connected module shall be determined by the module type, and shall be defined in the system software through the application of a personality code. Simply changing the associated personality code may change module operation at any time.
- C. All addressing of the Microprocessor-based Addressable Modules shall be done electronically, and the electrical location of each module shall be automatically reported to the Fire Alarm Control Panel, where it may be downloaded into a PC, or printed out. The addressing of the modules will not be dependent on their electrical location on the circuit.
- D. All Microprocessor-based Addressable Modules shall have a visual means to confirm communications with the panel, and a visual means to confirm the alarm status of the modules.
- E. All field wiring to the Microprocessor-based Addressable Modules shall be supervised for opens and ground faults and shall be location identified to the module of incidence.

- F. Diagnostic circuitry, and their associated indicators, with reviewable Trouble Codes, shall be integral to the Microprocessor-based Addressable Modules to assist in troubleshooting system faults.
- G. The module shall be suitable for operation in the following environment:
 - 1. Temperature: 32°F to 120°F (0°C to 49°C)
 - 2. Humidity: 0-93% RH, non-condensing
- H. Single Input Module:
 - 1. Microprocessor-based Addressable Modules shall be used to provide one (1) supervised Class B (style B) input circuit capable of latching operation for use with contact devices, non-damped Waterflow Switches, non-latching supervisory sprinkler switches.
- I. Dual Input Module:
 - 1. Microprocessor-based Addressable Modules shall be used to provide two (2) independent supervised Class B (style B) input circuits capable of operating with two (2) contact devices. Both of the input circuits shall be terminated to, and operated from, the same microprocessor-based addressable module. The Initiating Device Circuit connected to the module shall be fully supervised for open circuits and ground faults.
 - 2. Modules shall report the operation of Waterflow Switches. The modules shall have an automatic delay of 15 seconds before reporting the Waterflow alarm condition to the Fire Alarm Control Panel. Module shall monitor sprinkler supervisory switches. The module shall automatically report the supervisory function to the Fire Alarm Control Panel each time the associated dry contact closes. Refer to project sprinkler drawings for sprinkler riser locations and quantities.
- J. Single Riser Signal Module:
 - 1. The Microprocessor-based Addressable Single Input Signal Module shall provide one (1) supervised Class B (style Y) Notification Appliance Circuit capable of a controlling 2A of polarized 24 VDC Notification Appliances.
- K. Control Relay Module:
 - 1. Microprocessor-based Addressable Control Relay Modules shall provide one form "C" dry relay contact rated at 2 amps @ 24 Vdc or 0.5 amps at 120 VAC to, control external appliances or equipment processes. The control relay module shall be rated for pilot duty applications and releasing systems service. The position of the relay contact shall be confirmed by the system firmware.
- L. Microprocessor-Based Addressable Manual Pull Stations
 - 1. Fire Alarm / Life Safety System shall incorporate microprocessor-based addressable Manual Pull Stations connected over a 2 wire electronic communications loop, using both broadcast and serial polling protocols. All Manual Pull Stations shall display communications and alarm status via integral LED's.
 - 2. All addressing of the Microprocessor-based Addressable Manual Pull Stations shall be done electronically, and the electrical location of each station shall be automatically reported to the Fire Alarm Control Panel, where it may be downloaded into a PC, or printed out. The addressing of the Manual Pull Station will not be dependent on their electrical location on the circuit.

3. All field wiring to the Microprocessor-based Addressable Manual Pull Stations shall be supervised for opens and ground faults. All ground faults shall be location identified to the module of incidence.
4. Diagnostic circuitry, and their associated indicators, with reviewable Trouble Codes, shall be integral to the Microprocessor-based Addressable Manual Pull Stations to assist in troubleshooting system faults, including ground faults on the device.
5. Manual Fire Alarm stations shall be double action and shall be supplied with a Safety Technology International, Inc., STI-1100 Stopper II protective cover with self-contained horn.

2.8 FIRE ALARM NOTIFICATION APPLIANCES - GENERAL REQUIREMENTS

- A. All appliances which are supplied for the requirements of this specification shall be UL Listed for Fire Protective Service, and shall be capable of providing the "Equivalent Facilitation" which is allowed under the Americans with Disabilities Act Accessibilities Guidelines (ADA(AG)), and shall be UL 1971 Listed.
- B. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturer's instructions.
- C. Any appliances that do not meet the above requirements, and are submitted for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purpose intended. All strobes shall be provided with lens markings oriented for wall mounting. It shall be possible to replace the lens of any installed strobe in order to facilitate the replacement of a broken lens, or to change the orientation of the lens markings. Removal of an installed strobe to facilitate the changing of a lens will not be acceptable.
- D. All appliances installed in gymnasiums shall be equipped with a wire-guard protective cover. American Wire Guards brand, or equivalent.
- E. Speaker/Strobes
 1. Provide low profile white wall mount horn/strobes at the locations shown on the drawings. The Speaker/Strobe shall provide an audible output of 90 dBA at 10 ft. when measured in reverberation room per UL-464. Strobes shall provide synchronized flash outputs. The strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 60cd, 75cd. & 110cd devices. The horn shall have a selectable steady or synchronized temporal output. In and Out screw terminals shall be provided for wiring. Low profile horn/strobes shall mount in a North American 1-gang box.
- F. Strobes
 1. Provide low profile ceiling mounted white strobes at the locations shown on the drawings. In and out screw terminals shall be provided for wiring. Strobes shall provide synchronized flash outputs. Strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 60cd, 75cd, or 110cd devices. Low profile strobes shall mount in a North American 1-gang box.

- F. Remote LCD Annunciators:
 - 1. Remote LCD annunciators shall have the full ability and duplicate all functions of the main user interface located on the control panel. This includes the ability to control all system functions and duplicate panel annunciation.
 - 2. Annunciator shall also include the ability to support programmable switches and or LED's as required for special functions with out the need to add additional wires or cabinets.

2.9 ADDITIONAL EQUIPMENT

- A. Contractor shall include in their pricing, the cost to furnish and install the following additional equipment. These devices shall be used to fulfill any changes request issued until the list is depleted. Upon the completion of the project, all remaining material shall be delivered to the project for owner stock. No devices shall be used without documentation and written authorization from the project's technology consultant. Contractor shall obtain a signed transmittal of additional equipment to the owner at the end of the project. The signed transmittal shall be included in the contractor's closeout documents.
- B. Additional Equipment List:
 - 1. (15) Ceiling Mounted Audiovisual Strobes
 - 2. (15) Ceiling Mounted Visual Strobes
 - 3. (5) Manual Pull Stations
 - 4. (5) Stopper II tamper deterrent covers
 - 5. (3) Duct Detectors with sample tube and LED notification device
 - 6. (20) Ceiling Mounted, Photoelectric Smoke Detectors with base
 - 7. (10) Ceiling Mounted, Fixed Temperature, Heat detectors with base
 - 8. (8) Sets of keys to the FACP front locking panel

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The complete system shall be installed by one (1) contractor and the installing contractor must be a certified dealer of the specified system. **NO SUBCONTRACTORS, TO THE AWARDED PROPOSING CONTRACTOR, WILL BE ALLOWED TO INSTALL ANY PORTION OF THIS SYSTEM.** Including, but not limited to:
 - 1. Wiring
 - 2. Field device installation
 - 3. System programming
 - 4. FACP installation
 - 5. Remote power supply installation
- B. The installing contractor shall install the network fire alarm system in as instructed by the manufacturer's instructions.
- C. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- D. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- E. Manual pull stations shall be suitable for surface mounting or semi flush mounting as

shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

F. Smoke detectors shall be properly protected throughout construction.

G. Wiring:

1. **ALL WIRE ASSOCIATED WITH THE FIRE ALARM SYSTEM SHALL BE NEW AND RED IN COLOR ON THE ENTIRE PROJECT. NO EXCEPTIONS.**

2. All wiring shall be in accordance with NFPA 72, the National Electrical Code, Local Codes, and article 760 of NFPA Standard 70. All wiring sizes shall conform to recommendations of the equipment manufacturer, and as indicated on the engineered shop drawings.

3. All wire shall be U.L. Listed FPL for limited energy (300V) and fire alarm applications and shall be installed in conduit. Limited energy FPLP or MPP wire may be run open in return air ceiling plenums provided such wire is U.L. Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.

4. No A.C. wiring or any other wiring shall be run in the same conduit as fire alarm wiring.

5. Wiring used for the multiplex communication circuit (SLC) shall be twisted and support a minimum wiring distance of 10,000 feet when sized at 12 AWG. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit. Shielded wire shall not be required.

6. All field wiring (with exception of external communications Ethernet) shall be electrically supervised for open circuit and ground fault.

7. Minimum wire sizes shall be as follows:

a. Initiating Zones: 18 AWG

b. Indicating Zones: 14 AWG

c. Relay Control Circuits: 18 AWG

5. The fire alarm control panel shall be capable of T-tapping NFPA Style 4 (Class B) Signaling Line Circuits (SLCs). Systems which do not allow or have restrictions in, for example, the amount of T-taps, length of T-taps etc., is not acceptable.

6. Contractor shall ensure that all exterior horn locations will be installed in a weatherproof enclosure and sealed watertight. It is the contractor's responsibility that the conduit and box be installed in a manner that allows the device to be securely installed at all exterior locations and provide waterproofing as required to protect device and wiring.

7. Fire alarm system dialer shall be installed in accessible location near main fire alarm panel. Dialer shall be installed in its own panel box. Dialer shall be a Notifier 411 series. Dialer shall be powered from 24vdc source from the Notifier panel.

8. Contractor shall provide a service loop located above each device installed on the entire project. The service loop shall be a minimum of 5'.

9. Contractor shall provide a service loop located above each type of panel installed. The service loop shall be a minimum of 10', but shall have enough length to allow for the panel to be relocated to any wall within the room that panel is located in.

10. All service loops shall be installed in the accessible ceiling that is nearest to each device and panel. No service loops shall be installed in open spaces or non accessible spaces.

H. Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their use and purpose.

- I. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod. The control panel enclosure shall feature a quick removal chassis to facilitate rapid replacement of the FACP electronics.
- J. Cable Support:
 1. All wire not installed inside conduit shall be installed in a dedicated cable support system for the entire run of each cable. Including, but not limited to service loops.
- a. Approved Cable Support Product:
PANDUIT® Corporation J-MOD™ modular support system
 1. The approved cable support system shall be attached directly to the building steel at a serviceable height. In the event that the building steel is not 5' of the finished ceiling, the contractor shall provide a dedicated threaded rod extending within 5' of the finished ceiling and mount support hook to the treaded rod.
 2. cable support shall be installed at a maximum of 5' on center.
 3. All cable installed shall be attached to the support system with plenum rated Velcro and a plenum rated Velcro tie shall be installed between each cable support to keep wires neatly bundled throughout the entire run. Tiewraps will only be allowed to be used inside the fire alarm panels as required to manage the wires within each type of panel.
 4. **ABSOLUTELY NO CABLE, NOT INSTALLED IN CONDUIT, WILL BE ALLOWED TO BE ATTACHED DIRECTLY TO THE BUILDING'S STEEL OR SUPPORTED IN ANY OTHER METHOD THAN THAT STATED ABOVE.**
 5. **IT IS THE RESPONSIBILITY OF THE INSTALLING CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES ON THE PROJECT TO INSURE THAT THE PATHWAY OF THIS SYSTEM DOES NOT INTERFERE WITH THE INSTALLATION OF THE OTHER TRADES AND TO PREVENT THE INSTALLED PRODUCT OF OTHER TRADES FROM PUTTING STRAIN ON THE INSTALLED WIRING.**
- K. Conduit / Raceway:
 1. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.
 2. Conduit and raceway system shall be installed as specified under the general electrical section of the specifications, and per NEC, local, and state requirements.
 3. Minimum conduit size shall be 3/4" (19.1 mm). Install conduit per engineered shop drawings.
 4. Systems utilizing open wiring techniques with low smoke plenum cable shall provide conduit in all inaccessible locations, inside concealed walls, all mechanical/electrical rooms, or other areas where wiring might be exposed or subject to damage.
 5. All vertical wiring and all main trunk/riser wiring shall be installed in a complete raceway/conduit system. All riser boxes shall be adequately sized for the number of conductors transversing the respective box as well as the number of terminations required.
 6. Cable must be separated from any open conductors of power, or Class 1 circuits,

and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.

7. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
8. Conduit shall not enter the fire alarm control panel or any other remotely mounted control panel equipment or back boxes, except where conduit entry is specified by the FACP manufacturer.
9. All wiring associated with smoke control system shall be installed in conduit per current adopted codes regardless of voltages or ratings.

3.2 TEST AND REPORTS

A. Test:

1. The service of a state licensed, factory trained NICET level II technician shall be provided to technically supervise and participate during all of the adjustments and tests for the system. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system.
2. All testing shall be in accordance with NFPA 72, Chapter 10.
3. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
4. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
5. Verify activation of all water flow switches.
6. Open initiating device circuits and verify that the trouble signal actuates.
7. Open and short signaling line circuits and verify that the trouble signal actuates.
8. Open and short notification appliance circuits and verify that trouble signal actuates.
9. Ground all circuits and verify response of trouble signals.
10. Check presence and audibility of tone at all alarm notification devices.
11. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
12. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
13. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.
14. The installing contractor shall functionally test each and every device in the entire system for proper operation and response. In addition, each circuit in the system shall be fully tested for wiring supervision. Any items found not properly installed or non-functioning shall be replaced or repaired and retested.
15. The installing contractor shall provide a complete written report on the functional test of the entire system. A copy of the test report shall be provided with maintenance manuals. The test report shall be signed and dated by the licensed fire alarm superintendent responsible for supervising the final system test and checkout.

B. Final Inspection:

1. The installing contractor's state licensed, factory trained NICET level II technician shall test the entire system in the presence of the local authorities having jurisdiction. The contractor shall be responsible for making any changes, adjustments, or corrections as may be required by the local authorities.
- C. Closeouts:
1. It is the intent of these specifications and of the architect/engineer that a continued program of system maintenance be continued by the owner in compliance with NFPA Standard 72H. It is mandatory that the installing contractor provide such services and make available these services to the owner upon completion of the project.
 2. As part of the closeout documents, fire alarm contractor will provide owner with AutoCAD asbuilt drawings indicating locations of devices, routing of wiring, and panel information. All room numbers indicated on final close out documents and all panel settings shall be listed by actual building room numbers and not by room number indicated on construction documents. CAD files shall be AutoCAD 2017 or later. Provide the owner with one Mylar plot of each drawing and two blue line prints of each drawing.
 3. Provide the owner with electronic versions of the as-built CD's.
 4. Locate next to building FACP and fire alarm annunciator panel
 5. A building graphic shall be provided mounted in aluminum-extruded frame with plexi-glass front. Graphic shall locate all fire alarm devices, power supplies, and FACP.
 6. State FML-005 certificate shall also be framed and mounted near the fire alarm panel. Fire alarm panel shall have white FM required installation sticker attached to it.
 7. Graphic shall include actual room numbers posted as part of the building graphics package, include as part of substantial completion requirement.

3.3 WARRANTY

- A. The fire alarm system, including labor and material, shall be free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of acceptance or beneficial occupancy, whichever shall occur first. Any equipment or workmanship shown to be defective shall be repaired, replaced or adjusted during normal working hours at no cost to the owner.
- B. The equipment manufacturer shall be represented by a local service organization and the name of such shall be furnished to the Owner, Architect, and Engineer.

3.4 FUNCTIONS

- A. Alarm System Automatic Functions:
 1. Upon the operation on any sprinkler flow switch, manual pull station, or detector:
 - a. Signal the Fire Alarm Control Panel. Identify the addressable point at the Fire Alarm Control Panel and the remote fire alarm annunciator.
 - b. Sound a distinctive evacuation signal throughout the entire building.
 - c. Simultaneously activate all flashing visual alarm assemblies associated with audible indicators.
 - d. Shut down all mechanical equipment rated 2000 cfm or greater that circulate air for that floor. This equipment shall include, but shall not be limited to, air handling units, ventilation fans, fan powered boxes, and side pocket boxes. Coordinate with Division 15 Specification Section Air

- Conditioning Controls as required for passive smoke control.
- e. Close all smoke control dampers. Provide control relay within three (3) feet of each damper or power supply for motor drives or fail-safe dampers. When fail-safe smoke dampers are powered in parallel from a common power circuit then fire alarm relay may be provided to interrupt common power circuit; separate relay not necessary at every such damper. Install supervised fire alarm wiring from relay to fire alarm control panel. Resetting fire alarm system shall include opening smoke control dampers.
 - f. Activate and automatic telephone dialer and alarm contact closure for use with approved central station monitoring service. Owner provides NFPA 71 central station connection and maintains that service.
 - g. Release all fire and smoke control doors on hold-open devices so that doors may close.
 - h. Kitchen:
 - 1) Operation of any kitchen hood fire suppression system shall initiate the alarm building fire alarm control panel. Building fire alarm system shall sound alarm over appropriate notification appliance circuits as required by NFPA 72 sect. 3-8.8.1. Comply with NFPA 96 Standard for Commercial Cooking Operations, sect. 7-3.1.4. Actuation of a dry chemical shall cause building fire alarm per NFPA 17 sect. 3-7.4. Actuation of a wet chemical system shall cause building fire alarm per NFPA 17 sect. 3-2.1.5
 - i. Sprinkler System:
 - 1) Operation of any sprinkler system water flow switch shall activate the sprinkler alarm belt.
 - j. All alarm signals shall continue sounding and annunciator(s) shall remain lighted until the alarm acknowledged switch is depressed. The alarm signals shall then stop, but the annunciator shall remain lighted until the system is rest.
 - k. Acknowledging of any alarm signal shall interfere with the re-activating of the alarm signals upon an alarm from another zone.
 - l. Alarm Verification:
 - 1) Provide UL listed alarm verification feature.
 - 2) Alarm verification shall be per addressable, open area smoke detector. Alarm verification shall be field programmable on an individual detector basis. Global or dydte, alarm verification will be unacceptable.
 - 3) If an alarm condition is detected by an automatic smoke detector programmed for ALARM VERIFICATION, an alarm verification sequence shall be initiated. Upon receipt of the initial alarm condition, start the verification sequence as prescribed by UL 864. The system shall rest the alarmed zone/device within the UL prescribed window of 60 seconds maximum. If the alarm condition does not confirm within 60 seconds of the reset signal, the programmed alarm outputs shall be canceled and the system returned to the normal mode. If the alarm condition re-occurs within the designated verification cycle or a non-verified device or zone activates, the programmed events listed above shall immediately occur for the confirmed alarm condition.
 - 4) Alarm verification shall not be used for any spaces programmed to required two smoke detectors to initiate an alarm response (ex. elevator lobbies), per NFPA 72-1993 Sect. 3-8.2.5.

FIRE ALARM SYSTEM

3.5 WALK TEST

- A. Notify Owner, Architect and Engineer when system is 100 percent operational. Schedule walk-through of the entire facility and verify that each initiating and each indicating device is operating properly.
- B. Provide report at conclusion of walk through certifying all fire alarm devices are working.
- C. Walk test shall include a representative from owner maintenance department.
- D. Walk test to show in a printed report all AHU shutdown, Sprinkler Tamper Report, Sprinkler Flow switch, strobes/horns, and smoke detectors. Report shall list all devices by approximate location to rooms, and device number. All duct detectors shall include flow differential at the detector as measured by a manometer. Manometer reading shall match manufacturer's specification for duct detector used.

3.6 SOFTWARE

- A. Installer shall provide a backup copy of the installed program database on CD media and 8GB thumb drive upon completion of the project.
- B. Provide the current version of system software, for the panel provided, on CD and 8GB thumb drive.
- C. Install additional CDs and 8GB thumb drives containing the installed program database, framed under plastic at the FACP and each annunciator panel.

END OF SECTION 28 31 00

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and **abandoning site utilities in place**.
8. Temporary erosion and sedimentation control.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.
2. Section 015639 "Temporary Tree and Plant Protection"

- C. Related Requirements:

1. Section 01500 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.
2. Section 015639 "Temporary Tree and Plant Protection"
3. Section 024119 "Selective Demo"

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.
- D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 3 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.
- E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and **according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."** Ref. Tree protection plan and sheet for details.
- G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project Site

1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video recordings.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.
- B. Topsoil stripping and stockpiling program.
- C. Rock stockpiling program.
- D. Plan indicating existing vegetation protection and fence layout

- E. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.
- F. Burning: Documentation of compliance with burning requirements and permitting of authorities having jurisdiction. Identify location(s) and conditions under which burning will be performed.

1.7 QUALITY ASSURANCE

- A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
- B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Architect.
- C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.
- D. Utility Locator Service: Notify **utility locator service** for area where Project is located before site clearing.
- E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- F. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.
- B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with **surface-tolerant, anticorrosive metal primer**.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

- A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed **or abandoned in place**.
 - 1. Arrange with utility companies to shut off indicated utilities.
 - 2. Owner will arrange to shut off indicated utilities when requested by Contractor.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- E. Excavate for and remove underground utilities indicated to be removed.
- F. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 3. Use only hand methods or air spade for grubbing within protection zones.
 - 4. Chip removed tree branches and Dispose of off site.

- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth **6 inches** in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Limit height of topsoil stockpiles to **96 inches**.
 - 2. Do not stockpile topsoil within protection zones.
 - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
 - 4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 STOCKPILING ROCK

- A. Remove from **construction area** and stock pile naturally formed rocks that measure more than **2 foot** across in least dimension. Do not include excavated or crushed rock.
 - 1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 1 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- B. Stockpile rock **away from edge of excavations** without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.
 - 1. Limit height of rock stockpiles to **48 inches**.
 - 2. Do not stockpile rock within protection zones.
 - 3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.
 - 4. Stockpile surplus rock to allow later use by the Owner.

3.8 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Burning tree, shrub, and other vegetation waste is permitted according to burning requirements and permitting of authorities having jurisdiction. Control such burning to produce the least smoke or air pollutants and minimum annoyance to surrounding properties. Burning of other waste and debris is prohibited.
- C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 31 10 00

SECTION 32 13 14 – PEDESTRIAN CONCRETE PAVING

PART 1 - GENERAL:

1.1 SUMMARY:

- A. Section Includes:
1. Concrete bands, sidewalks, and pavements.
 2. Sawcut jointing patterns
 3. Expansion joints

1.2 REFERENCES:

- A. American Concrete Institute (ACI)
1. 211.1-77 Recommended Practice for Selecting Proportions for Normal Weight Concrete.
 2. 214-77 Recommended Practice for Evaluation of Compressive Test Results of Field Concrete
 3. 305-73 Recommended Practice for Hot Weather Concreting.
 4. 306-66 Recommended Practice for Cold Weather Concreting.
 5. 347-68 Recommended Practice for Concrete Formwork.
- B. American Society for Testing and Materials (ASTM)
1. A-82-76 Cold Drawn Steel Wire for Concrete Reinforcement.
 2. A615-78 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 3. C33-78 Concrete Aggregates.
 4. C94-78 Ready Mixed Concrete.
 5. C150-78a Portland Cement.
 6. C260-77 Air Entraining Admixtures.
 7. C330-77 Lightweight Aggregates for Structural Concrete.
 8. C494-79 Chemical Admixtures for Concrete.
 9. D1751-73 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and resilient Bitumens Type).

1.3 QUALITY ASSURANCE:

- A. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
 - 1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.
- C. Testing Laboratory Services
 - 1. Perform all required tests and coordinate all efforts with the designated testing laboratory.
 - 2. Cooperate with testing laboratories to permit proper testing and inspection procedures.
- D. Source Limitations:
 - 1. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

1.4 SUBMITTALS:

- A. Forms: Submit Data with complete illustrations and/or descriptions for the following:
 - 1. Inserts, anchors, sleeves and other embedded items.
 - 2. Expansion joint fillers.
 - 3. Vapor Barrier
- B. Cast-In-Place Concrete:
 - 1. Mix Designs:
 - a. Mix Designs for each type of concrete
 - 2. If mix designs are based upon field experience with materials to be used, submit substantiating data at time of submitting mix designs. If suitable field performance data cannot be provided, submit laboratory confirmatory test results upon each proposed mix design. Use only mix designs accepted in writing by Owner's representative.
 - 3. Product Data: Submit to Owner's representative for each mix design:
 - a. Certified mill reports on cements.
 - b. Certified sieve analysis on aggregates.
 - c. Cement manufacturer's name and brand name.
 - d. Manufacturer's name and brand names of materials listed as products of more than one approved manufacturer.
 - 4. Truck Delivery Tickets: Include on each ticket:
 - a. Certification required by ASTM C94.
 - b. Type and brand name of cement.

- c. Amount of cement, in pounds.
 - d. Total amount of water, in gallons.
 - e. Maximum size aggregate.
- C. Shop Drawings: Submit six (6) copies of sub-slab shop drawings indicating expansion joint layout. Layout shall be submitted in conjunction with granite shop drawings. Expansion joints shall align accordingly.
- D. Samples: Approved samples shall be the standards for finishes in concrete work.
1. Flatwork: Provide 5' x 5' samples of each mix and finish specified until approved by Landscape Architect. Samples shall be representative of the finish concrete and shall include, but not limited to; expansion joints, control joints, saw cut joints, patterning, finish, and color.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Store new and reusable form lumber and form plywood under heavy waterproof coverings or where well protected from inclement weather.
- B. Stack oiled form plywood on sticking to permit proper ventilation between uses.
- C. Handle and store metal forms in such manner as to prevent damage by denting, warping, twisting and rusting.
- D. Deliver reinforcing to site in easily handled bundles with identification tags securely wired into place. Store reinforcing to prevent damage and protect from corrosion and deformation.

1.6 PROJECT CONDITIONS:

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

1.7 GENERAL REQUIREMENTS:

- A. All concrete work shall be true to line and grade as indicated on the drawings. The Contractor shall be responsible for proper drainage, without birdbaths, on all concrete paving surfaces. Any discrepancies or omissions on drawings, or conditions on the site, which prevent this Contractor from providing proper drainage shall be brought to the attention of the Owner's representative in writing for correction or relief before work proceeds.
- B. Surface Tolerance: Finished paving surfaces shall not vary more than 1/4" inch measured with a 10' metal straight edge, except at grade changes. No birdbaths or other surface irregularities will be permitted. Correct irregularities as directed.

1.8 ENVIRONMENTAL CONDITIONS:

- A. Observe provisions of ACI-305 when ambient temperature is 90 degrees F. and greater.
- B. Observe provisions of ACI-306 when ambient temperature is 40 degrees F. and less.

PART 2 – PRODUCTS

2.1 PORTLAND CEMENT:

- A. Shall conform to current requirements of ASTM Designation C150, Type I or II cement.

2.2 COARSE AGGREGATE:

- A. ASTM C - 33; 1"-3/8" limestone.

2.3 FINE AGGREGATE:

- A. Sand shall be clean, hard and durable with uncoated grains free from injurious amounts of silt, loam clay or other deleterious matter, conforming to ASTM C33, grade in size from coarse to fine with 95-100% by weight passing a #4 sieve, 45-70% passing a #16 sieve, 15-30% passing a #50 sieve and 3-8% passing a #100 sieve.

2.4 WATER:

- A. Provide clean, potable, concrete mixing water free from injurious amounts of salts, oils, acids, alkalis, organic materials or other deleterious matter.

2.5 AIR ENTRAINMENT:

- A. Air-entraining admixture shall conform to ASTM C260.

2.6 WATER REDUCING AGENTS, RETARDERS, ACCELERATORS:

- A. ASTM C494: Water reducing, normal setting admixture: Type A. Water reducing, retarding admixture: Type D.

2.7 VAPOR BARRIERS:

- A. Vapor Barrier (Under all slabs) shall comply with ASTM E1745 Class A, maximum WVTR 0.008, minimum 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.8 REINFORCING:

- A. Reinforcing Bars: ASTM A615, Grade 60, deformed billet-steel, clean and free from rust, scale, or coating that will reduce bond.
- B. Welded Wire Fabric: Not acceptable.
- C. Cold Drawn Steel Wire: ASTM A82.
- D. Bar Chairs: 16 gauge galvanized steel wire, with 3" x 3" base, or solid plastic of proper sizes and design to properly support and position reinforcing steel.

2.9 METAL DOWELS:

- A. ASTM A36.

2.10 EXPANSION JOINT MATERIALS:

- A. Premolded Joint Filler: To be "Sonoflex-F", a closed cell plastic joint filler, as manufactured by Sonneborn-Contech, Building Products Division, Contech, Incorporated, or approved equal.
- B. Joint Sealant: To be "Sonolastic Sealant Two-Part" as manufactured by Sonneborn-Contech, Building Products Division, Contech, Incorporated, or approved equal. Color shall match adjacent concrete work.
- C. 1/2" thick Asphalt saturated fiber expansion joint filler: Preformed with dowels as provided by Contractors Paving Supply in Stafford, Texas or approved equal.
- D. Metal Screed Key joints: As indicated on the drawings as provided by Sheplers, Houston, Texas or approved equal
- E. All expansion joint material shall be 1/2" thickness.

2.11 CURING MEMBRANE:

- A. Submit a manufacturer of a spray on curing membrane to be used on all exposed concrete surfaces for approval. Conform to ASTM 309.
- B. Select a fugitive color for above

- C. In lieu of above, submit a plan for slow curing all concrete for approval by the Owner's Representative

2.12 WOOD FORMS:

- A. Form Lumber: Number 2 Southern pine or Number 2 Douglas Fir-Larch, surfaced four sides; true and straight members free from cupping, warping, loose knots, excessive checking and other structural defects.
- B. Moldings and Chamfer Strips: "C-Select" or "Finish" Southern pine, straight, sound, and free of knots and other defects.
- C. Used form materials may be reused provided that they are thoroughly cleaned and acceptable finishes can be produced.

2.13 METAL FORMS:

- A. Heavy gauge steel of sufficient strength to prevent undue deflection, properly braced. Use only materials with smooth and regular contact surfaces, free from dents and irregularities that affect regularity and finish surface of concrete.

PART 3 - EXECUTION

3.1 DESIGN OF MIXES AND PROPORTIONING:

- A. Proportioning and mixing of cement, aggregate, admixture and water to attain required plasticity and strength shall be in accordance with ACI-304.
- B. Concrete Mixture: Concrete mixtures shall be designed by an approved commercial testing laboratory at no expense to the Owner, using approved materials furnished by the Contractor to obtain a minimum compressive strength of 4,000 pounds per square inch at 28 days of age and an air content by volume of 6% plus or minus 1.0 percent. The slump of the concrete shall be not more than 4".

3.2 SETTING FORMWORK:

- A. Forms shall be constructed accurately to dimensions, plumb and true to line and grade. Forms shall be substantial, mortar tight and braced, and tied so as to maintain position and shape during placing of reinforcing and concrete. Wavy surfaces and bulged walls or slab surfaces resulting from settlement or springing of formwork will not be acceptable.
- B. Do not re-use forms for exposed concrete surfaces. Coat all wood forms with form oil or release agent before pouring. Release agent shall be required on form surfaces where concrete is exposed to view in finished work.

- C. Forms shall be constructed and assembled in such a manner that construction joints shall occur at approved locations.
- D. Care shall be taken in all details of forming, setting, reinforcing, mixing and placing all concrete exposed in finish work to obtain smooth, even surfaces of dense concrete, and clean sharp inside and outside corners, except where tooled corners are indicated. Use of form oil will be required to prevent concrete from bonding to form.
- E. Forms shall be carefully observed and checked for alignment and level as the work proceeds. All needed adjustment or additional bracing shall be done promptly.
- F. Forms shall remain in place long enough to allow concrete to set properly and the Contractor shall assume all responsibility for removing same.

3.3 VAPOR BARRIER

- A. Plastic Vapor Barriers: Place, protect, and repair vapor barriers according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturers recommended tape.
- B. Granular Course: Cover vapor barrier with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.
 - 1. Place and compact a 1/2-inch- thick layer of fine-graded granular material over granular fill.

3.4 PLACING REINFORCEMENT:

- A. Place all reinforcement as shown on drawings. Place accurately and securely fasten and support reinforcement to prevent displacement before or during pouring. Support bars and/or wire mesh with suitable reinforcing chairs.
- B. Do not heat bars for bending or straightening. Do not tack weld bars.
- C. Clean, bend and place reinforcement in accordance with current requirements of the ACI Manual of Concrete Practice.
- D. Reinforcement Splices:
 - 1. Reinforcing bars - 24 bar diameter minimum, except as otherwise noted.

3.5 PLACING CONCRETE:

- A. Concrete shall be deposited so as to require as little rehandling as practicable. All placing equipment shall be clean and free from hardened concrete.

- B. Placing shall be continuous between transverse joints or in individual sections of the work. Spade concrete thoroughly along forms and expansion joints, and work carefully into corners and around reinforcement. Tamp and screed to a dense mass.
- C. Convey concrete from mixer to place of final deposit in one continuous operation and until entire unit being placed is complete. Maintain plasticity of concrete to flow readily into formwork and embed reinforcement without segregation of aggregates.
- D. Use chutes of uniform shape and slope controlling concrete fall to not more than 3'.
- E. Place no partially hardened, contaminated or retamped concrete.

3.9 FINISHES:

- A. Medium broom Finish: Shall be obtained by drawing a medium bristled broom across a floated finish. Direction of brooming to be perpendicular to direction of walk or as otherwise shown on drawings.

3.10 JOINTS: (Reference Drawings for Locations of each type joint.)

- A. Score Joints: Score joints shall be formed in the fresh concrete using a jointer to cut the groove so that a smooth uniform impression is obtained. All joints shall be struck before and after brooming/troweling. Contractor to fabricate special score joint tools as shown on plans.
- B. Expansion Joints and Edging: Expansion joints shall be formed provided at the location and intervals as shown on the plans, and at all locations where concrete paving abuts buildings, curbs, or other structures. Approved joint material shall be placed with top edge 1/2" below the paved surface, and shall be securely held in place to prevent movement. Joint and other edges shall be formed in the fresh concrete using an edging tool to provide a smooth uniform impression. All edges shall be struck before and after brooming. After the curing period, expansion joints shall be carefully cleaned and filled with approved joint compound to 1/4" below paved surface in such a manner as to avoid spilling on paved surfaces or overflow from joint.
- C. Saw Cut Joints: Sawing of joints shall be sawn as soon as the concrete will support the weight of the saw and the operator without marking or damaging the concrete. The saw cut shall be 1/4" wide by 1/4 the depth of the slab and shall have chamfered edges as detailed by using the Soff-Cut Ultra Early Entry system with ProEdge beveled blades or approved equal.

3.11 CURING AND PROTECTION AND PATCHING:

- A. Protect concrete against frost, rapid drying and damage by rain and keep moist for at least 7 days after placing. Protect during this period by wet burlap, canvas covering (ASTM 171) or liquid curing compound. Curing by the use of saturated burlap. Sprinkler or membrane where approved shall commence immediately upon completion of finishing.

Secure Owner's approval of proposed method. During this period, maintain concrete above 70 degrees F. for at least 3 days or above 50 degrees F. for at least 5 days. Concrete from which forms are removed within 7 days after pouring shall be sprayed during the curing period as frequently as drying conditions may require. Concrete covering shall be a type that will not stain or discolor finished concrete surfaces. Cure concrete in accordance with requirements of the current ACI Manual of Concrete Practice. Apply a spray on curing compound in accordance with manufacturer's recommendation and as specified herein where allowed.

B. Protect all concrete work against injury and defacement to walls and steps during subsequent construction operations, and until acceptance by the Owner.

C. PATCHING:

1. The use of "pavecrete" or other surfacing material will not be permitted.
2. Minor chips (2" X 2") or less which occasionally occur as a result of related construction activities may be patched using approved material.
3. The color and finish of all patches must exactly duplicate the surrounding pavement.
4. Remove any stains or spills on finished concrete work immediately.
5. Upon completion of the work clean all areas.
6. Remove any chalk lines used for sawcut joint layout

END OF SECTION 32 13 14

SECTION 32 33 00 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bike racks.
 - 2. Bollards
- B. Related Requirements:
 - 1. Section 03 30 10 "Cast-in-Place Concrete" for installing pipe sleeves cast, installing anchor bolts cast in concrete footings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Samples for Verification: For each type of exposed finish, not less than 6-inch- long linear components and 4-inch- square sheet components.
- E. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Trash Receptacle Inner Containers: Two full-size units for each size indicated.

PART 2 - PRODUCTS

2.1 SITE FURNISHINGS

- A. Products: Refer to the Drawings Sheet L4.00 – Materials Schedule.

2.2 FABRICATION

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- E. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.3 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.4 ALUMINUM FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.5 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.
- B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with

coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

2.6 IRON FINISHES

- A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.7 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run directional finishes with long dimension of each piece.
 - 2. Directional Satin Finish: No 4.
 - 3. Dull Satin Finish: No. 6.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
- E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch larger than OD

of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

- F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

END OF SECTION 32 33 00

SECTION 32 33 13 - SITE BICYCLE RACKS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Exterior bicycle racks.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Mounting surface for bicycle racks.
- B. Section 05 50 00 - Metal Fabrications: Custom metal outdoor furnishings.
- C. Section 32 13 13 - Concrete Paving: Mounting surface for bicycle racks.
- D. Section 32 33 14 - Site Bicycle Lockers.
- E. Section 32 33 15 - Site Bicycle Shelters.

1.3 PRICE AND PAYMENT PROCEDURES

- A. See Section 01 23 00 - Alternates for product alternatives affecting this section.
- B. This section describes a base bid product; refer to Section _____ for an alternative product.
- C. This section describes an alternative product; refer to Section _____ for the base bid product.

1.4 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- C. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
- D. ASTM A312/A312M - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes; 2022a.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- H. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
- I. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- J. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- K. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2017a.
- L. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.

1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.

- C. Shop Drawings: Indicate size, shape, and dimensions, including clearances from adjacent walls, doors, and obstructions.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Handle racks with sufficient care to prevent scratches and other damage to the finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Exterior Bicycle Racks:
 - 1. American Bicycle Security Company; _____: www.ameribike.com/#sle.
 - 2. BRP by Bison, Inc; _____: www.brpbybison.com/#sle.
 - 3. Columbia Cascade Company; _____: www.timberform.com/#sle.
 - 4. Highland Products Group, LLC; _____: www.indoorbikeracks.net/#sle.
 - 5. Huntco Supply, LLC; _____: www.huntco.com/#sle.
 - 6. MADRAX, a brand of Graber Manufacturing, Inc; _____: www.madrax.com/#sle.
 - 7. Neenah Foundry, a division of Neenah Enterprises, Inc; _____: www.nfco.com/#sle.
 - 8. Reliance Foundry Co. Ltd; _____: www.reliance-foundry.com/#sle.
 - 9. Saris Infrastructure; _____: www.sarisinfrastructure.com/#sle.
 - 10. _____.
 - 11. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 BICYCLE RACKS

- A. Exterior Bicycle Racks: Device allows user-provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
 - 1. Style: Serpentine rack formed from a continuous round pipe.
 - 2. Style: Staggered, alternating serpentine rack formed from a continuous round pipe.
 - 3. Style: Serpentine rack formed from square tube.
 - 4. Style: Staggered, alternating serpentine rack formed from square tube.
 - 5. Style: Inverted horseshoe rack formed by one u-shaped bend of round pipe.
 - 6. Style: Hitching post formed by two upright and one horizontal length of square tube.
 - 7. Style: Round loop.
 - 8. Style: Square loop.
 - 9. Style: Coil.
 - 10. Style: Round bollard with half circle attachment loops.
 - 11. Style: Square bollard with half circle attachment loops.
 - 12. Style: Fence style; one-sided, with top, bottom, and side frame; vertical dividers and wheel stop.
 - 13. Style: Bed frame style with top, bottom, and side frame and vertical dividers.
 - 14. Style: Arch with logo plate.
 - 15. Style: Decorative.
 - 16. Style: Sculptural.
 - 17. Style: Hollow plastic panel, designed to be filled with water or sand; with slots for bicycle wheels and holes for locking mechanisms.
 - 18. Style: Precast concrete.
 - 19. Style: Custom configuration as indicated on drawings.
 - 20. Style: _____.
 - 21. Capacity: Seven bicycles.
 - 22. Mounting, Ground: In-ground anchor.
 - 23. Mounting, Wall: Post-installed anchor.

24. Finish: Powder coat, maintenance-free and weather-resistant.
25. Finish: Satin brushed.
26. Finish: Integral color.
27. Color: As selected by Architect from manufacturer's standard range.
28. Color: As indicated on drawings..
29. Accessories: In-ground grout cover.

B. Materials:

1. Pipe: Carbon steel, ASTM A53/A53M, Schedule 40.
2. Pipe: Stainless steel, ASTM A312/A312M, Type 304, Schedule 40S.
3. Tube: Carbon steel, ASTM A500/A500M.
4. Tube: Stainless steel, ASTM A269/A269M, Grade TP304, seamless.
5. Bar, Round and Flat, Carbon Steel: ASTM A36/A36M.
6. Bar Round and Flat, Stainless Steel: ASTM A666, Type 304.
7. Molded or Extruded Plastic: 100 percent, high-density, UV stabilized polyethylene.
8. Precast Concrete:
 - a. Cement: ASTM C150/C150M, Portland Type I - Normal; white color.
 - b. Concrete Materials: ASTM C33/C33M aggregate, water, and sand.
 - c. Reinforcing Steel: ASTM A615/A615M, deformed steel bars; unfinished, strength and size required by precast unit design.
 - d. Concrete Mix: Minimum 5000 psi (34 MPa), 28 day strength, air entrained to 5 to 7 percent.
 - e. Air Entrainment Admixture: ASTM C260/C260M.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive bicycle racks.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.
- C. Do not begin installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Ensure surfaces to receive bicycle racks are clean, flat, and level.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install level, plumb, square, and correctly located as indicated on drawings.
- C. In-Ground Anchor Installation:
 1. Prepare holes in size according to manufacturer's instructions.
 2. Place anchoring bolts through the holes in pipe.
 3. Lower rack into holes, ensuring the bottom of lower bends are at least 1-1/2 inch (38 mm) from the ground.
 4. Place concrete.
 5. Level rack before concrete sets.
 6. Support until dry.
- D. Post-Installed Anchors: Comply with ICC-ES AC308.
- E. Surface Flange Installation: Anchor bicycle racks securely in place with 1/2 inch (13 mm) by 4 inch (101 mm) anchor bolts through flange holes.
- F. Freestanding Installation: Place in location indicated on drawings.

3.4 CLEANING

- A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 32 91 00 - SOIL PREPARATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Furnish components of the planting mediums.
 2. Testing and/or certifications of components
 3. Mixing of planting mediums.
 4. Transporting mediums as required.
 5. Weed Control
- B. Related Sections:
1. Finish Grading - Section 31 22 15
 2. Sprinkler Irrigation System - Section 32 84 00
 3. Lawns and Grasses - Section 32 92 00
 4. Planting - Section 32 93 00

1.02 QUALITY ASSURANCE

- A. Certificates of Inspection: Certificates of inspection required for transportation shall accompany invoice for each shipment of materials. File copies of certificates with Landscape Architect after acceptance of material.
- B. Testing:
1. Chemical and Physical - All soil components shall be tested by one of the following testing laboratories for conformity to the specifications:

Texas Plant and Soil Lab
5115 West Monte Cristo
Edinburg, Texas 78539
(956) 383-0739

A&L Plains Agricultural Laboratories, Inc.
302 34th Street
Lubbock, Texas 79404
(806) 763-4278

Soil and Plant Laboratory, Incorporated
Post Office Box 153
Santa Clara, California 95052
(408) 243-0330
 2. Biological:
Soil Food Web, Inc.
1128 NE 2nd Street Suite 120
Corvallis, Oregon 97330
www.soilfoodweb.com
(541) 752-5066
 3. If herbicide contamination is suspected, then a radish/rye-grass growth trial must be performed.

4. For delivered material, test one grab sample for each fifty (100) cubic yards of bulk material delivered to the site.
5. Testing will be at the expense of Contractor.
6. Deviations greater than plus or minus twenty (20%) percent from control data may be grounds for rejection of mixes tested. Non-conforming materials shall not be used. Materials which do not conform to standards specified herein shall be removed from the site.

1.03 SUBMITTALS: Furnish copies of manufacturers literature, certifications, sources, samples, or laboratory analytical data for the following items:

1. Existing soil testing data
2. Organic Amendments and Fertilizers
3. Planting Soil
4. Topsoil.
5. Sand.
6. Native Mulch (composted).
7. Compost.
8. Herbicides

PART 2 PRODUCTS

2.01 PLANTING SOIL:

A. Grading:

Sieve Size	Percent Passing Sieve
25.4 mm (1")	95-100
9.51 mm (3/8")	85-100
53 Micron (270 mesh)	10- 30

B. Chemistry - Suitability Considerations:

1. Salinity: Saturation Extract Conductivity (ECe x 103 @ 25 degrees C.) less than 2.2 mmhos/cm.
2. Sodium: Sodium Absorption Ratio (SAR) less than 9.0.
3. Boron: Saturation Extract Concentration less than 2.0 ppm.
4. Reaction: pH of Saturated Paste: 6 - 7.5.

C. Pests:

The population of any single species of plant pathogenic nematode: Fewer than 500 per pint of soil (confirm by biological testing).

D. Fertility Considerations:

Soil to contain sufficient quantities of available nitrogen, phosphorus, potassium, calcium, and magnesium to support normal plant growth. In the event of nutrient inadequacies, provisions shall be made to add required materials to overcome inadequacies prior to planting.

E. Source of above shall be approved and conformity of material shall be laboratory verified for each 100 cubic yards of material delivered to the site.

F. Percentage of Organic Matter: Min. 4-8%

G. Physical Soil Parameters

1. Clay: 5-25%
2. Silt: 25-50%
3. Sand: 25-50%

2.02 ON SITE MATERIAL:

A. Specified backfill mixes shall consist of on site material generally conforming to the requirements in this specification.

B. Test on site topsoil from designated stockpile area or borrow site for conformity to this specification. Submit test to Landscape Architect for verification and alteration of components.

2.03 WOOD RESIDUALS:

A. Source:

Shall be non-composted and/or stockpiled, and not have been chemically treated or dyed.

B. Physical Properties - Grading:

U.S. Sieve Dry Weight Percent Passing

3/8"	100
1/4"	90 - 100
No. 8	70 - 100
No. 35	0 - 30

C. Organic Content by Ash Analysis:

90 - 100 Percent Dry Weight

D. Chemistry Range:

1. Saturation Extract Conductivity (ECc) Nil - 3.5

2. Reaction (pH) 6-8

E. Salinity: Maximum saturation extract conductivity 3.5 millimhos per cm @ 25 degrees centigrade.

2.04 SAND:

A. Physical Properties - Grading:

U.S. Sieve Percent Passing

No. 4	100
No. 10	95 - 100
No. 18	90 - 100

No. 35	65 - 100
No. 60	0 - 50
No. 140	0 - 20
No. 270	0 - 7

B. Chemistry: Range:

1. Saturation Extract Conductivity (ECc) Nil - 3.0
2. Sodium Absorption Ratio (SAR) Nil - 6.0
3. Boron - ppm in saturation extract solution Nil - 3.0
4. Reaction (pH) 6.0 - 7.5
5. Available calcium - sodium acetate extractable - ppm dry weight Nil - 4000
6. Soluble-Salt Content: 1 to 2dS/m measured by electrical conductivity
- 7.

C. Coarse Sand – concrete sand

2.05 COMPOST:

Made from recycled natural materials screened to 1" minus (for soil additive). On the Solvita compost maturity test score, must score a value of 5 or higher for tilling into the soil and be a minimum of 6 months old and fully composted. Supplied by Nature's Way Resources, Inc., Conroe, Texas or approved equal.

A. Chemical components:

1. pH - 6.0-8.0
2. Nitrogen – 30 ppm or higher
3. Phosphorus – 150 ppm or higher
4. Potassium – 400 ppm or higher
5. Calcium – 3000 ppm or higher
6. Magnesium – 250 ppm or higher
7. Salinity – 2500 ppm or lower
8. Zinc – 6 ppm or higher
9. Iron – 25 ppm or higher
10. Manganese – 16 ppm or higher
11. Copper – 0.4-2.0 ppm
12. Sodium – 1000 ppm or less
13. Sulfur – 25 ppm or higher
14. Boron – 2 ppm or higher

B. Biological components:

1. Bacteria – minimum of 150 micrograms per gram of soil of total bacteria
2. Fungus – minimum of 150 micrograms per gram of soil of total fungus
3. Protozoa
 - a. flagellates – 10,000 units per gram of soil
 - b. amoebae – 10,000 units per gram of soil
 - c. ciliates – 20 units per gram of soil

2.06 CHEMICAL ADDITIVES (OR EQUIVELANTS):

The following soil components listed may have a particular application specified within this Section. Some of the soil components included shall be applied at rates determined by the soil tests called for under other paragraphs of this Section or as a result of soil tests. Some of the components may not be required by the soils tests. All additives shall be the slow release type.

- A. Ground Limestone: Agricultural limestone containing not less than eighty five (85%) percent of total carbonates, ground to such fineness that fifty (50%) percent will pass a 100 mesh sieve and ninety (90%) percent will pass a 20 mesh sieve.
- B. Dolomite Lime: Agricultural grade mineral soil conditioner containing thirty five (35%) percent minimum magnesium carbonate and forty nine (49%) percent minimum calcium carbonate, 100 percent passing #65 sieve. Kaiser Dolomite 65 AG or approved equal.
- C. Gypsum: Agricultural grade product containing eighty (80%) percent minimum calcium sulphate.
- D. Iron Sulphate (Ferric or Ferrous): Shall contain thirty (30%) to thirty five (35%) percent iron, thirty five (35%) to forty (40%) percent sulphur and be supplied by a commercial fertilizer supplier.
- E. Sulphate of Potash: Agricultural grade containing fifty (50%) percent to fifty three (53%) percent of water soluble potash.
- F. Single Superphosphate: Commercial product containing nineteen (19%) to twenty (20%) percent available phosphoric acid.
- G. Ammonium Sulphate: Commercial product containing approximately twenty one (21%) percent ammonia.
- H. Calcium Nitrate: Agricultural grade containing fifteen and one-half (15 1/2%) percent Nitrogen.
- I. I.B.D.U. (Iso Butyl diene Diurea): Commercial product containing thirty one (31%) percent Nitrogen.
- J. Soil Sulphur: Agricultural grade sulphur containing a minimum of ninety six (96%) percent sulphur.
- K. Iron Chelate Micronutrient: Sequestrene - 330 Fe; 0-0-0; ten (10%) percent Fe; Ciba-Geigy Company.

2.07 FERTILIZERS AND NUTRIENT AMENDMENTS: all 100% organic

- A. Fertilizer: MicroLife organic fertilizer as supplied by San Jacinto Environmental Supplies, Houston, Texas or approved equal.
- B. Minor and Trace Elements: Humates Plus 0-0-4 as supplied by San Jacinto Environmental Supplies, Houston, Texas or Green Sand as supplied by Nature's Way Resources, Inc. or approved equals.

PART 3 EXECUTION

PLANTING

3.01 LAWN AND NATIVE SEED AREAS – Hydromulch and Sod

- A. After finish grade approval and before laying sod or spreading seed apply:
 - 1. 2" layer of compost uniformly across area

2. 20# of MicroLife 6-2-4 fertilizer per 1,000 sq. ft.
 3. 10# of MicroLife humates plus 0-0-4 trace elements per 1,000 sq. ft.
 4. After laying sod or spreading seed, foliar spray the entire area with 8oz of MicroLife Super Seaweed mixed with a gal of water. Each gallon of mix to cover 1,000 sq. ft.
- B. Disk or till into the soil to a depth of 2"-4" until the amendments are fully incorporated before seeding and/or planting (See Section 32 92 00).

3.02 SHADED GROUNDCOVER AREAS

- A. After finish grade approval apply:
1. 1" layer of Compost uniformly across area
 2. 3" (in) Planting Soil
 3. 40# of MicroLife ultimate 8-4-6 fertilizer per 1,000 sq. ft.
 4. 10# of MicroLife humates plus 0-0-4 trace elements per 1,000 sq. ft.
- B. Disk or till into the soil to a depth of 4" until the amendments are fully incorporated before groundcover planting (See Section 32 92 00).

3.03 TREE PLANTING AREAS (Within Tree Excavation Pit)

- A. After finish grade approval before mulching apply:
1. Backfill with imported planting media (See Section 32 93 00)
 2. For every 15 gal. tree size, add 6 oz. MicroLife Ultimate 8-4-6
 3. 3 oz of JRM Mycorrhizal Tree Transplant
 4. 2 oz of MicroLife Super Seaweed mixed with a gal. of water. Use 2 gal. of mixed solution per 15-gal. tree size

3.04 SUNNY GROUNDCOVER AND PERENNIAL AREAS

- A. After finish grade approval apply:
1. 4"(in) Planting Soil
 2. 40# of MicroLife ultimate 8-4-6 fertilizer per 1,000 sq. ft.
 3. 10# of MicroGro Granular per 1,000 sq. ft.
 4. 2 oz of MicroLife Maximum Bloom 3-8-3 mixed with a gal. of water as a new plant/root stimulator. Water soak the area sufficiently to get uniform saturation.
- B. Disk or till into the soil to a depth of 4" until the amendments are fully incorporated before planting (See Section 32 93 00).

3.05 SHRUB PLANTING

- A. After finish grade approval before mulching apply:
1. 4"(in) Planting Soil
 2. 40# of MicroLife ultimate 8-4-6 fertilizer per 1,000 sq. ft.
- B. Disk or till into the soil to a depth of 6" until the amendments are fully incorporated before planting (See Section 32 93 00).

3.06 EXISTING TREES (12"+ cal.)

- A. Once a year treatment
1. 2 gal. of MicroLife Bio-Matrix 7-1-3

2. 6 oz of JRM Mycorrhizal Injectables per 100 gal. of water

3.07 WEED CONTROL/TREATMENT

- A. All site locations to receive planting where weeds exist, shall be treated with post-emergent herbicide.
 1. Repeat treatment as required to ensure that no weeds are present at the beginning of work on the landscape planting of the Project.
- B. Weeds shall not be present at the date of inspection for Substantial Completion of the Project and at the conclusion of the maintenance and establishment period following acceptance of the Contractor's work
- C. Post-emergent weed treatment includes:
 1. Removal of weeds and other undesirable ground cover vegetation in turf/grass and planting areas shall be accomplished a minimum of 14 days prior to soil preparation for planting operations.
 2. Care shall be taken not to affect existing trees, shrubs, and plants on and near the site.
- D. Pre-Emergent Herbicide treatment:
 1. Apply per manufacturers distribution rate prior to mulching and directly after mulching.
 2. Snapshot, Princep or Specticle are approved Pre-Emergents. Contractor to submit product for approval.

END OF SECTION 32 91 00

SECTION 32 92 00 - LAWNS AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Hydromulch Seeding and Soil Supplements
 - 2. Dry Application Seeding.
 - 3. Solid Sod Installation

- B. Related Sections
 - 1. Finish Grading - Section 31 22 15
 - 2. Planting - Section 32 93 00
 - 3. Landscape Maintenance - Section 93 94 00

1.2 QUALITY ASSURANCE

- A. Source:
 - 1. Seed: The Owner's representative shall be furnished a signed copy of statement from vendor, certifying that each container of seed delivered is labeled in accordance with the Federal Seed Act and is at least equal to requirements previously specified. Seed analysis shall be furnished prior to commencement of planting operations. Each lot of seed may be resampled and retested in accordance with latest Rules and Regulations under the Federal Seed Act at the discretion of the Owner's representative. If these tests reveal the seed to be below the specified pure live seed content, the Contractor shall be required to plant additional seed to compensate for the deficiency at no additional cost to the Owner. The State Seed Laboratory will conduct the seed retests. Allowance will be made for the actual pure live seed content of the specified grasses in determining the actual planting rate.

- B. Inspections:
 - 1. Make written request for inspection after seeding operations have been completed. Such inspection is for the purpose of establishing the Maintenance Period.
 - 2. Submit written requests for inspections to the Owner's representative at least 7 days prior to anticipated inspection date.

1.3 SUBMITTALS

- A. Furnish required copies of manufacturers literature, certifications, or laboratory analytical data for the following items:
 - 1. Seed source. (Certification)
 - 2. Fiber mulch. (Laboratory analytical data)
 - 3. Tank mix fertilizer. (Certification or laboratory analytical data)
 - 4. Topdress fertilizer. (Certification)

1.4 MAINTENANCE BY THE CONTRACTOR (refer to section 32 94 00)

1.5 FINAL ACCEPTANCE

- A. Work under this Section will be accepted by Owner's representative upon satisfactory completion of all work, but exclusive of re-application under the Guarantee Period. Final Acceptance of lawn or prairie establishment shall be as follows:

1. For Sod: Complete lush cover with no brown sections or cracks showing. Sod shall have established to the extent that satisfactory capillary action between the sod and soil has been established.
2. For Lawn Seed: 95% uniform coverage of grass in excess of 1" height. No bare spots of greater than 2 square feet will be accepted.
3. For Native Seed: 90% coverage of plants in excess of 6" height. No bare spots greater than 2 square feet will be accepted.
4. The Owner's representative and/or Owner shall interpret the above. Upon Final Acceptance, the Owner will assume the responsibility for maintenance of the work.
5. If the seeding season for Native Grass Mix is missed due to the wrong season for proper germination and grow-in, the contractor is required to return to the project site and apply seed the following appropriate season at no additional cost to the owner. **Native seed shall be installed March-June.**

PART 2 - PRODUCTS

2.1 SEED

- A. All seed used shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act. All seed shall be furnished in sealed standard containers unless exception is granted in writing by the Owner's representative. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable.
- B. The minimum percentage by weight of pure live seed in each lot of seed shall be as follows and seed shall be planted at the rate per acre indicated under pure live seed required per acre.

Kind of Seed	Minimum % Pure Live Seed Required	Pounds Pure Live Seed Required Per Acre
COMMON BERMUDA	95	20

Note: % Pure Live Seed = % Purity X % Germination

- C. Weed seed shall not exceed 10% by weight of the total of pure live seed and other material in the mixture. Johnson grass, nut grass, or other noxious weed seed will not be allowed.
- D. If Native American Seed Mixes seeding seasons are missed the contractor will be required to seed Perennial Rye at a rate of 15 pounds per acre and return the following season to install the specified grass at no cost to the owner.

2.2 FERTILIZER FOR TANK MIX

- A. MicroLife Multi-Purpose 6-2-4, pelleted, uniform in composition, free-flowing, and suitable for application with approved equipment. The fertilizer shall be delivered to the site in bags or other convenient containers, each fully labeled, conforming to the applicable state fertilizer laws, and bearing the name or trademark and warranty of the producer.

2.3 WOOD CELLULOSE FIBER MULCH

- A. Wood Cellulose fiber mulch, for use with the hydraulic application of grass seed and fertilizer, shall consist of specially prepared wood cellulose fiber. It shall be processed in such a manner that it will not contain germination or growth inhibiting factors. It shall be dyed an appropriate color to allow visual metering of its application. The wood cellulose fibers shall have the

property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like groundcover which readily absorbs water and allows infiltration to the underlying soil. Weight specifications from suppliers for all applications shall refer only to air dry weight of the fiber, a standard equivalent to 18% moisture. The mulch material shall be supplied in packages having a gross weight not in excess of 100 pounds and be marked by the manufacturer to show the dry weight content. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished and that it meets all of the foregoing requirements.

2.4 WATER

- A. Drinkable, directly from local utility supply.

2.5 SLURRY MIX COMPONENTS PER ACRE

- A. Wood Cellulose Fiber Mulch 2,000 pounds
- B. Grass Seed (as specified)
- C. Fertilizer (13-13-13) 800 pounds

2.6 SOD

- A. One year old sod, ref. planting schedule for sod selection. Sod shall be dense with the grass having been mowed at 1" height before lifting from field. All grown on fumigated soil. Sod shall be in vigorous condition, dark green in color, free of disease and harmful insects. Do not stack for more than 24 between time of cutting and time of delivery. Owner's representative reserves the right to reject any sod deemed unacceptable for installation.

2.7 TOPDRESS FERTILIZER

- A. (Delayed Application) Complete fertilizer, 50% of the nitrogen shall be derived from natural organic sources or urea-form. Available phosphoric acid shall be from superphosphate, bone, or tankage. Potash shall be derived from muriate of potash containing 60% potash. Apply at rate to achieve 1.5 # N/1000sf.
 - 1. 16% Nitrogen
 - 2. 6% Phosphoric Acid
 - 3. 8% Potash

2.8 TOPDRESS MIX

- A. Topdressing under existing trees shall be:
 - 1. 2/3 Cubic Yard Planting Soil-Ref. 32 9100
 - 2. 1/3 Cubic Yard Sand-Ref. 32 9100

PART 3 - EXECUTION

3.1 HYDROMULCH SEEDING OF BERMUDA GRASS AND PRAIRIE SEED ON PREPARED FINISHED GRADE

- A. Bed Preparation:
 - 1. Ref. Soil Preparation 32 91 00
 - 2. Rake or Harrow 3"-4" deep

- B. Hydroseeding:
 - 1. Immediately after the finished grade has been approved, begin hydroseeding operation to reduce excessive weed growth.
- C. Perimeter Sodding:
 - 1. Install two courses of sod at perimeter of area to receive hydroseeding. Install in compliance with requirements of "SODDING ON PREPARED FINISHED GRADE" requirements below.
- D. Special Mulching Equipment and Procedures:
 - 1. Hydraulic equipment used for the application of fertilizer, seed, and slurry of prepared wood fiber mulch shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry containing up to 40 pounds of fiber plus a combined total of 70 pounds of fertilizer solids for each one 100 gallons of water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles, which provide even distribution of the slurry on the slopes to be seeded. The slurry tank shall have a minimum capacity of 800 gallons and shall be mounted on a traveling unit which may be either self-propelled or drawn with a separate unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded so as to provide uniform distribution without waste. The Owner's representative may authorize equipment with smaller tank capacity provided that the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.
- E. Mixing:
 - 1. Care shall be taken that the slurry preparation takes place on the site of the work. The slurry preparation should begin by adding water to the tank when the engine is at half throttle. When the water level has reached the height of the agitator shaft, good re-circulation shall be established and seed shall be added. Fertilizer shall then be added, followed by wood pulp mulch. The wood pulp mulch shall only be added to the mixture after the seed and when the tank is at least one-third filled with water. The engine throttle shall be opened to full speed when the tank is half filled with water. All the wood pulp mulch shall be added by the time the tank is two-thirds to three-fourths full. Spraying shall commence immediately when the tank is full. The operator shall spray the area with a uniform, visible coat by using the green color of the wood pulp as a guide.
- F. Application:
 - 1. Obtain approval of hydromulch area preparation from the Owner's representative prior to application.
 - 2. Operators of hydromulching equipment shall be thoroughly experienced in this type of application. Apply specified slurry mix in a motion to form a uniform mat at specified rate.
 - 3. Keep hydromulch within areas designated and keep from contact with other plant material.
 - 4. Slurry mixture which has not been applied within 4 hours of mixing shall not be used and shall be removed from the site.
 - 5. After application, do not operate equipment over the covered area.
 - 6. Immediately after application, thoroughly wash off any plant material, planting areas, or paved areas not intended to receive slurry mix. Keep all paved and planting areas clean during maintenance operations.
 - 7. Refer also to the maintenance portion of this Section.
- G. Unseeded Areas: Reseed unplanted areas with the specified grasses at no additional cost to the Owner.

3.2 DRY APPLICATION SEEDING FOR NATIVE GRASS/BERMUDA GRASS MIXES

- A. Seed Bed Preparation:
 - 1. Ref. Soil Preparation 32 91 00
 - 2. Rake or Harrow 3"-4" deep

- B. Seeding:
 - 1. Plant seed with a broadcast seeder or a Culti-packer seeder. Plant grass seed no deeper than ¼ inch and the distance between rows 12 inches or less. Distribute seed evenly.
 - 2. Roll the planted seedbed with a Culti-packer immediately after seeding and prior to applying mulch cover.
 - 3. Seed may be broadcast by hand for small areas or areas inaccessible to seeding equipment, as approved by the Engineer. Areas seeded by hand shall be rolled or lightly compacted, if possible.

- C. Mulching:
 - 1. Spread straw or hay mulch on seeded areas with a slope steeper than 8H:1V immediately after application of seed.
 - 2. Apply straw or hay mulch at a rate per acre of 2000lbs., to create a uniform mat of coverage a minimum of ½ inch thick to protect the seedbed.
 - 3. Secure straw or hay mulch with hydromulch or other approved methods.
 - a. Apply a hydromulch, consisting of a homogeneous aqueous mixture of recycled paper fiber, water and tackifier or soil stabilizer, to achieve a rate of 1,000 pounds of paper fiber mulch per acre over the straw mulch. Apply guar gum tackifier at a minimum rate of 50 pounds (dry weight) per acre.
 - b. Application rate for other tackifier or soil stabilizer compounds shall be in accordance with the manufacturer's recommendations and approved by the Engineer.

3.3 SODDING ON PREPARED FINISHED GRADE

- A. Bed Preparation:
 - 1. Ref. Soil Preparation 32 91 00
 - 2. Immediately after the finished grade has been approved, begin sodding operations to reduce excessive weed growth. If sod bed is dry immediately prior to sod installation, dampen surface with a fine mist of water.

- B. Installation:
 - 1. Lay sod so that adjacent strips butt tightly with no spaces between strips. Lay sod on mounds and slopes with strips parallel to contours. Stagger joints. Sodded areas shall be flush with adjoining seeded areas. At walks and pavements lay one strip of sod parallel to pavement and make cuts at this strip. At back of curb there shall be a double sod strip totaling 36" so that it can be maintained with a 36" wide mower deck.
 - 2. Tamp and roll sod thoroughly to make contact with sod bed.
 - 3. Peg sod on slopes three to one or steeper with pegs driven through sod into soil until pegs are flush with turf. Space pegs 18" on center. Pegs shall be 1" square by 6" pine or 6" lengths of lath.
 - 4. Water sod thoroughly immediately after fertilizing.
 - 5. Roll sod with 200 lb ballast roller immediately after sod has been installed and watered.

3.4 CLEAN UP

- A. Keep all areas of work clean, neat, and orderly at all times. Keep all paved areas clean during lawn installation operations. Clean up and remove all deleterious materials and debris from the entire work area prior to Final Acceptance to the satisfaction of Owner's representative.

3.5 INSPECTIONS

- A. Make written request for inspection prior to seeding and after areas have been seeded and sodded.
- B. Submit requests for inspections to Owner's representative at least 2 days prior to anticipated inspection date.

END OF SECTION 32 92 00

SECTION 32 93 00 - PLANTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plants.
 - 2. Tree stabilization.
 - 3. Tree-watering devices.
 - 4. Landscape edgings.
 - 5. Landscape mulches and gravels

- B. Related Requirements:
 - 1. Section 32 92 00 "Lawns and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.
 - 2. Section 32 91 00 "Soil Preparation"

1.2 COORDINATION

- A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 - 2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
 - 3. Irrigation inspection tube and cap materials.
 - 4. Fertilizer tablets for tree installation

- B. Samples for Verification: For each of the following:
 - 1. Mulch: 1-quart volume of mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

2. Planting Soil Mix: 1-quart volume of mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
3. Weed Control Barrier: 12 by 12 inches.
4. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
5. Tree Staking Materials and Accessories: post, hose, and webbing (sample of each)

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 2. Experience: Three years' experience in landscape installation in addition to requirements in Section 01 4000 "Quality Requirements."
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
 - a. Landscape Industry Certified Technician - Exterior.
 - b. Landscape Industry Certified Interior.
 - c. Landscape Industry Certified Horticultural Technician.
 5. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
 1. Selection of plants shall be made by Architect, who tags plants at their place of growth before they are prepared for transplanting.
- C. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball.
- E. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.
- F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- H. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 2. Do not remove container-grown stock from containers before time of planting.
 3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
 2. Warranty Periods: From date of Substantial Completion.
 - a. Trees: 1 year.
 - b. Shrubs, Vines, Ornamental Grasses, Ground Covers, Biennials, Perennials, and Other Plants: 1 year
 - c. Sod: 1 year
 - d. Annuals: Three months.
 3. Include the following remedial actions as a minimum:
 - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
 - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Annuals: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery.

2.2 FERTILIZERS

- A. Trees: Ref 32 9100 "Soil Preparation" for fertilizer selection
- B. Shrub, groundcover, annuals and perennials: MicroLife all organic fertilizer as supplied by San Jacinto Environmental (713) 957-0909. Apply at mfg. max. recommended rates. Ref. Section 32 9100- "Soil Preparation"

2.3 MULCHES

- A. Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 - 1. Type: Hardwood mulch
 - 2. Grind: 1.5"x2"max, Double Ground
 - 3. Color: Natural (Brown)
 - 4. Depth: 1.5" min 3.5" maximum
- B. Compost: Ref 32 91 00 "Soil Preparation"
- C. Rock Mulch:
 - 1. Decomposed Granite (¼ Minus)
 - a. Size: ¼" Minus
 - b. Clean, hard, durable particles of fragments of decomposed granite, "Salado Rose" available from Alamo Stone, Stafford, Texas (281) 240-4600 or approved equal.
 - c. Free of clay lumps, organic material, and deleterious material.
 - 2. Seinna Cobbles
 - a. Size: 2"-4", 6"-12"
 - b. Available from Alamo Stone, Stafford, Texas (281) 240-4600 or approved equal.

2.4 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.
- B. Miriafi 140 NL as manufactured by Nicolon Mirafi Group, Pendergrass, GA, (888) 795-0808 or approved equal.

2.5 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 TREE-STABILIZATION MATERIALS

- A. Stakes and Guys:

Contractor shall use staking materials necessary to meet requirements of specifications, subject to approval:

1. Tree Stakes: 7' & 8' long steel T-post weighing 1.33 pounds per foot.
2. Paint for Stakes: Pittsburgh Paint No. 515-5 Stonehenge Greige.
3. Tie Webbing: Tree Tie Webbing by AM Leonard-Green

2.7 LANDSCAPE EDGINGS

- A. Concrete Edging: Ref. Materials Schedule

2.8 MISCELLANEOUS PRODUCTS

- A. Root Barrier: Black, molded, modular panels manufactured with 50 percent recycled polyethylene plastic with ultraviolet inhibitors, 85 mils thick, with vertical root deflecting ribs protruding 3/4 inch out from panel, and each panel 24 inches wide.
- B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- C. Burlap: Non-synthetic, biodegradable.
- D. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.
- E. Planter Filter Fabric: Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.

- F. Mycorrhizal Fungi: Dry, granular inoculants containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable, and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
- E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

- F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth of 8 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply fertilizer directly to subgrade before loosening.
 - 2. Thoroughly blend planting soil off-site before spreading.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
 - 3. Spread planting soil to a depth indicated on the Drawings.
 - a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at maximum application rate recommended by manufacturer.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 1. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 - 2. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 - 3. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 - 4. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
 - 5. Maintain supervision of excavations during working hours.
 - 6. Keep excavations covered or otherwise protected when unattended by Installer's personnel.

7. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Follow Soil Preparation Execution. Ref. 03 91 00
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
 1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 1. Use planting soil for backfill. Follow soil preparation execution. Re. 039100
 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 4. Place planting tablets (Agriform Fertilizer 20-10-5 Plus Minors 21 mg) in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Set balled and potted, and container-grown stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 1. Use planting soil for backfill. Follow soil preparation execution. Re. 039100
 2. Carefully remove root ball from container without damaging root ball or plant.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets (Agriform Fertilizer 20-10-5 Plus Minors 21 mg) in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

3.6 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.
- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

3.7 TREE STAKING

- A. Staking of trees is to be used by the Contractor, who will be responsible for material remaining plumb and straight for all given conditions through the guarantee period. Tree support shall be done as outlined on the following tables.
- B. Staking shall be completed immediately after planting. Plants shall stand plumb after staking.
- C. Stake all trees in accordance with the following table:

Tree	Stakes	Stake Size
15-45 Gal. and B&B under 3"	2	6 ft Post
65 Gal. and B&B 3"& larger	3	7 ft Post

- D. Locate first stake on prevailing windward side of tree and as close to the main trunk as is practical, avoiding root injury. Stakes shall be driven at least 18" into firm ground.
- E. Tie tree to stake using approved tree tie. Tie shall be located midway within tree crown or at a location approximately 2/3 of the overall height of the tree. Locate tie just above major side branch in order to deter slippage of tie.
- F. Locate second stake opposite first. Secure with one tie opposite upper tie at first stake.
- G. Auxiliary stem stakes shipped with trees shall be secured as above after shipping.

3.8 ROOT-BARRIER INSTALLATION

- A. Install root barrier where trees are planted within 60 inches of paving or other hardscape elements, such as walls, curbs, and walkways unless otherwise shown on Drawings. Deep Root 24-2 or approved eq.
- B. Align root barrier vertically and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.
- C. Install root barrier continuously for a distance of 60 inches in each direction from the tree trunk, for a total distance of 10 feet per tree. If trees are spaced closer, use a single continuous piece of root barrier.
 - 1. Position top of root barrier flush with finish grade.
 - 2. Overlap root barrier a minimum of 12 inches at joints.
 - 3. Do not distort or bend root barrier during construction activities.
 - 4. Do not install root barrier surrounding the root ball of tree.

3.9 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on the Drawings
- B. Use planting soil for backfill. Follow soil preparation execution. Re. 039100
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees and Tree-like Shrubs in Turf Areas: As indicated on the Drawings or 3" depth
 - 2. Organic Mulch in Planting Areas: As indicated on the Drawings or 3" depth
 - 3. Mineral Mulch in Planting Areas: As indicated on the Drawings

3.11 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.12 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.13 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before [Substantial Completion] <Insert time>, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.14 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 32 93 00

SECTION 32 94 00 - LANDSCAPE GROUNDS MAINTENANCE FOR NINETY (90) DAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS: The Drawings, Division 0 and Division 1 apply to work under this Section.

1.2 SCOPE OF WORK:

A. Work included in Base Bid:

1. Monitoring adjustment and minor repair of the landscape irrigation system.
2. Mowing, edging and trimming of lawn areas.
3. Mowing of Love Grass and Native Grass Plantings
3. Pruning and trimming of plant materials.
4. Weed, cultivating and cleaning of planting beds, turf areas, and Native grass areas..
5. General site clean up; removal of trash and products of maintenance.
6. Applications of fertilizers, ant control, insecticides and herbicides.
7. Pruning and trimming of trees.
8. Mulching trees, shrubs, groundcovers and seasonal color.
9. Extra services as needed.

B. Work Not Included in Base Bid: (Extra Service)

1. Street cleaning - other than that required as a result of maintenance operations.
2. Replacement of plant material - other than that required under the one year warranty requirement.
3. Compost amendment application
4. Aerating lawn areas.
5. Overseeding with cool-season grasses.
6. Application of pre/post emergents.
7. Additional clean-up and/or plant material replacement relating to natural weather events including hurricanes, tornadoes, severe thunderstorms, major rain events causing flooding, freezing temperatures, ice/ice storms, extended periods of draught and snow.

1.3 EXTRA SERVICES:

The intent of the ninety day maintenance period is to provide a comprehensive maintenance program to include all required services, except those services specifically excluded, to perform the work for the stated time period.

1. All services not included in the list of Base Bid items shall be considered 'extra services' and will be charged for separately according to the nature of the item of work. The consent and authorization of the Owner's representative or their authorized representative must be obtained prior to the performance or installation of such "extra services" items and prior to purchase of any chargeable materials.
2. Such work may include replacement of dead plant materials other than what is already covered under the warranty period, major repairs of irrigation system, by-products of vandalism or other contracts or other site related work.

3. Application of pre/post emergents.
4. Authorized extra services work must be summarized weekly and submitted with receipts to the Owner's representative.
5. The Owner's representative is not bound by the specifications or contract to utilize the landscape maintenance contractor in the performance of "extra services" work.
6. The landscape maintenance contractor shall coordinate his activities with other contractors on the site so as to not hinder the performance of any work.
6. Authorized charges for extra work will be paid per the General Conditions of the Contract.

1.4 SUBSTITUTIONS:

- A. Specific reference to manufacturer's names and products specified in this Section are used as standards, but this implies no right to substitute other material or methods without written approval of the Owner's representative. Such permission must be secured without additional cost to Owner's representative.
- B. Installation of any approved substitution is Contractor's responsibility. Any changes required for installation of any approved substitution must be made to the satisfaction of and without additional cost to Owner's representative.

1.5 INTENT OF THE MAINTENANCE PROGRAM:

It is the intent of the maintenance program is to provide the Owner's representative with a project site that is attractive in appearance and keep all plant materials and lawns in a healthy and vigorous condition.

1.6 THE CONTRACT:

This Maintenance Contract is a period ninety days. The Contract can be terminated with cause.

1.7 CONTRACTORS PERFORMANCE:

The Contractor shall perform all work required once per week or as often as necessary to fulfill the spirit and intent of the Contract. The workmen shall be dressed in company uniforms and all required PPE (Personal Protective Equipment), and neat in appearance, perform their work in a professional manner, keep noise to a minimum and stage their work from a location on the site out of the way of the mainstream of the users. In general, the Contractor's presence on the site shall be as inconspicuous as possible.

1.8 COMMENCEMENT OF THE MAINTENANCE PERIOD:

This maintenance period shall become effective at the date of Substantial Completion.

1.9 NEGLECT AND VANDALISM:

1. Turf, shrubs, trees or plants that are damaged or killed due to contractors operations, negligence or chemicals shall be replaced at no expense to the Owner's representative. If plant damage or death is caused by conditions beyond the contractor's control, replacement shall be at the Owner's representative's expense.
2. Sprinklers or structures that are damaged due to the contractor's operations must be replaced by the contractor promptly. Likewise, damage to the irrigation system by others shall be corrected immediately by the contractor, at the Owner's representative's expense.
3. All water damage, either natural or man-made, resulting from contractor's neglect shall be corrected at the contractor's expense.
4. All damage to or thefts of landscaping and irrigation installations not caused or allowed by the contractor shall be corrected by the contractor at the Owner's expense upon receipt of written authorization to proceed.

1.12 EMERGENCIES:

1. The Contractor shall answer emergency or complaint calls within twelve (12) hours and corrective action shall be complete within twenty-four (24) hours.
2. The Contractor shall answer emergency calls regarding the Landscape Irrigation system failure or need of repair, and take corrective action within eight (8) hours. Such work, unless caused due to neglect on the part of the Landscape Maintenance Contractor, shall be considered "Extra Services".

1.13 JOB CONDITIONS:

- A. Contractor shall be familiar with all site conditions.

1.14 RESTRICTIONS:

- A. Do not use growth regulators or growth retardants or any chemicals that will have adverse effects on the organic fertilizers and soil conditioners utilized for this project.

PART 2 - PRODUCTS AND MACHINERY

2.1 MATERIALS:

Materials listed under this Section are expressly requested for use and does not prohibit or restrict the Contractor from providing other materials not listed in order to complete the work required herein.

1. Pre-Emergence Weed Control: Shall be Surflan A.S., Atrazine 4L or approved equal.
2. Post-Emergence Weed Control: Shall be Trimec Lawn Weed Killer, Sedge Hammer, Vantage, Image or approved equal.

3. Sufactant: Spreader Sticker shall be used with both pre and post emergence herbicides.
3. Herbicide: Shall be "Round Up", by Monsanto, St. Louis, Missouri.
4. Insecticide: Shall be Shall be "Astro Insecticide" as manufactured by FMC Corporation, Agricultural Products Group, 1735 Market Street, Philadelphia, PA 19103 (800.321.1362) or approved equal.
5. Fire Ant Control: Ortho Orthene Fire Ant Killer.
6. Compost: Made from recycled natural materials screened to 1" minus (for soil additive). On the Solvita compost maturity test score, must score a value of 5 or higher for tilling into the soil and be a minimum of 6 months old and fully composted. Supplied by Nature's Way Resources, Inc., Conroe, Texas or approved equal.
7. Fertilizer: FERTILIZERS AND NUTRIENT AMENDMENTS:
 - A. Fertilizer: MicroLife Hybrid 20-0-5, MicroLife Ultimate 6-2-4, and MicroLife Humates Plus 0-0-4 as supplied by San Jacinto Environmental Supplies, Houston, Texas or other approved equal supplier.
 - B. Contractor shall keep all empty bags with certificates intact and submit them to the Owner's representative.
 1. Submission of empty fertilizer bags is required to verify operation has been performed as specified.
 - C. Humate Soil Conditioner: Vigoro modified humate, Earthgreen Menefee Humate, Humate International AG 16-35 or approved equal.
 - D. Aerated Compost Tea: Natures Own or approved equal.
8. Tree Deep Feeding Fertilizer: Shall be Aerated Compost Tea with mycorrhizal fungi manufactured by Natures Own, MicroGrow or approved equal
9. Fungicide: Shall be "Systemic Fungicide" with Benomyl by Greenlight Products, San Antonio, Texas 78217, and/or Cleary Chemical 3336 WP "Turf and Ornamental Fungicide.
10. Fertilizer for annuals/perennials:

Nelson ColorStar Plus 19-13-6 with Fungicide

Foliar spray Maximum Blooms 3-8-3 Organic liquid color fertilizer
11. Soil Drenching Material: Shall be "Sub Due 2E", by the Agricultural Division of Ciba-Geigy Corporation, Greensboro, North Carolina 27409.
12. Mulch: Shall be equal to that already in use at the site. Shredded hardwood bark for groundcover areas.
13. Tree Stakes and Guys: Shall match those in use at the site.

2.2 MACHINERY:

Machinery requirements listed under this Section are not intended to be restrictions of specific manufacturers or models unless so stated. Specific mention of manufacturers is intended as a guide to illustrate the final product of maintenance operations desired.

1. Lawn Mowers: Shall be of the rotary type in good working order, finely tuned to protect the lawn from excessive exhaust fumes. Blades shall be sharp to reduce shredding of the cut grass blades.
2. Lawn Edgers: Shall be of a rigid or flexible blade type that will produce a fine clean edge where lawns meet walkways, pavements or curbs.
3. Fertilizer Spreaders: Cyclone type spreader or equal. No visible underlapping of applications will be permitted.
4. Deep Root Feeder: Shall be the Ross type by Ross Daniels, Incorporated, Des Moines, Iowa 50265.
5. Pruning Tools: Shall be maintained in good working order, cutting edges shall be sharp. Disinfect all tools when used for the removal of diseased limbs.

PART 3 - EXECUTION

3.1 LANDSCAPE IRRIGATION SYSTEM:

The Contractor shall monitor and program the automatic controlling devices to proceed optimum moisture levels in all planted areas.

1. Irrigation cycles shall be set to take place prior to sunrise (usually 4:00 - 5:00 am) unless otherwise instructed by the Owner's representative, except during visits of grounds maintenance personnel; during such visits the irrigation system may be operated as desired by those personnel.
2. Do not program controllers operating on the same water meter to water during the same time period so as to prevent over-draft of water meters. Do not switch controller to "off" at any time, except as required for testing and for maintenance operations.
3. Complete sprinkler system servicing shall be performed as required to maintain sprinklers in correct operating condition, including all required labor. Monitor and inspect sprinklers once a month or upon request of the Owner's representative. This check shall include visual "inspection" of all accessible components of the irrigation system including but not limited to controllers, remote control valves, quick couplers and heads.
4. Adjust sprinklers to avoid damage to automobiles, signs and also adjust heads to keep water off the street and sidewalks. Make repairs and alterations to the sprinkling system and water lines. All sprinklers repairs such as cleaning of heads or breaks caused by the Contractor shall be the Contractor's responsibility.
5. Minor repairs: Contractor shall make necessary repairs under \$300.00 without Owner's representative's approval to maintain operation of the system.

6. Replacement materials throughout the system shall be as specified in Section 02810.

3.2 TREES MAINTENANCE:

- A. Contractor shall maintain staking and guying of trees at all times and shall be responsible for any damage to trees or plant materials caused by chafing or breakage of foliage or limbs coming in contact with stakes or ties. Replace broken plant stakes and ties and bent stakes as needed. If ties are too tight, they must be replaced or adjusted. If stakes are not needed, remove.
- B. Trees that may require guys, stakes or special care during the winter winds and rains shall receive the required care prior to the time of rains and high winds to insure that no damage results to the plant material.
- C. All suckers shall be continually removed from trees.

3.3 SEASONAL AND PERENNIAL FLOWERS:

- A. The maintenance contractor shall continually maintain seasonal flower beds in all contract areas.
- B. Complete weeding, trimming, edging, and cultivation of all flower beds as required to keep the beds free of weeds, to promote growth and maintain neat, orderly appearance. As flowers cover open soil, cultivating shall be discontinued.
- C. Maintenance shall include:
 1. Pinching of blooms and pruning of dead or damaged foliage.
 2. Fertilize in alternate months with organic fertilizer. (RE: PART 2)
 3. Apply supplemental organic fertilizer to keep each type of seasonal flower performing at its optimum level.
 4. Spraying or dusting for disease or insect control as a preventive or corrective measure.
 5. Seasonal Color Change out: seasonal color change out after the initial planting (Extra Service) by the installing contractor.
- D. Fertilizer for annuals/perennials: Add ColorStar Plus 19-13-6 with Fungicide at the manufacturers recommended rate and feeding schedule. Foliar spray Maximum Blooms 3-8-3 Organic liquid color fertilizer (6 ounces per 1000 sq ft) & Garlic Oil (1 ounce per 1000 sq ft) mixed together with water and sprayed every 30 days.

3.4 HEDGE MAINTENANCE:

- A. Edge, weed, fertilize and cultivate all hedge beds in accordance with Schedule.

- C. The Owner's representative shall be notified prior to application and advised of any danger associated with the use of these products (i.e., to avoid personal contact with sprayed areas, etc.).
- D. Apply insecticides as needed to protect all plant materials from damage. The insect control program shall include slugs and snails and advance preventive spraying for twig borers. The Contractor shall be responsible for the choosing of chemicals and insecticides he uses and shall be accountable for any misuse of same.
- E. Apply the proper fungicide, herbicide and pesticides for the control of pests, weeds and plant diseases or treat cuts on exposed surfaces of trees or shrubs for disease and pest control on turf, plants and trees.

3.10 GENERAL CLEAN UP:

- A. The Contractor shall dispose of all waste materials or refuse from his operations legally off the property except where agreement is reached with the Owner's representative.
- B. All plant growth shall be prevented in any cracks in walks or within paved areas.
- C. Leaves, papers, grass clippings or other debris shall be removed at least weekly or at each visit from all areas.
- D. Trash receptacles shall be checked regularly and emptied, and trash removed from the site frequently enough so that trash never overflows the receptacles. Trash receptacles shall be lined with black plastic bags which shall be emptied and removed from the site daily.

PART 4.00 - SCHEDULE

4.1 SCHEDULE:

The Schedule as included herein shall govern the work. Should the Contractor require an alteration of the Schedule, contact the Owner's representative.

JANUARY: WEEKS 1, 2, 3, 4

TURF

The turf shall be watered as needed. Turf shall be raked during the latter part of the month, to remove thatch. Mow turf for the first time in week 4.

TREES, SHRUBS, AND VINES

Trees shall be pruned except flowering trees and flowering shrubs which shall be pruned after flowering. Do not change shape of tree, prune to enhance shape. Pre-emergent herbicides shall be applied if approved by Client. Weed beds as required.

FEBRUARY: WEEKS 1, 2, 3, 4

TURF

The turf shall be watered as needed. Turf shall be raked during the latter part of the month, to remove thatch. Mow turf weeks 2 and 4.

TREES, SHRUBS, AND VINES

Continue pruning trees. Apply tree fertilizer to established trees. Deep root feeding is method to use during this period. Iron and other elements shall be applied if needed. Fertilize acid loving plants as called out under "Material Used". Do not fertilize flowering shrubs until blooming is completed.

MARCH: WEEKS 1,2

TURF

Turf shall be mowed in week two. Mowing shall not remove more than one-quarter (1/4") inch off existing height. First application of fertilizer (Microlife Hybrid 20-0-5) shall be applied at manufacturer's maximum recommended rate. Water thoroughly after applying fertilizer. Mow first; then fertilize.

TREES, SHRUBS, AND VINES

Check Plants for adequate watering to prevent any winter damage. Water if necessary. Prune dead wood as required. Continue to weed beds.

Mulch shall be placed in all beds, a two (2") inch to three (3") inch layer over existing mulch if mulch is not adequate. Dead vines should be removed. Flowering plants should be fertilized only after blooming.

MARCH: WEEKS 3, 4

TURF

Mow as required; still only one-quarter (1/4") inch off existing growth. Water as required. Weed control should be continued. Replace any winter damaged sod at this time.

TREES, SHRUBS, AND VINES

Inspect evergreens for insects and diseases, spray as required. Spray for borers. Continue to weed beds. Fertilize trees and flowering shrubs if they have buds. Application should be 10-8-4 at a rate of ten (10) pounds per 1,000 square feet. Acid loving plants should be given special attention as called out in "Material Used".

APRIL: WEEKS 1, 2, 3, 4

TURF

Mowing should be continued; begin cutting one and one-half (1 1/2") inches to two (2") inches above grade. Water as required.

TREES, SHRUBS, AND VINES

Flowering plants should be through flowering and ready to be pruned and fertilized, if not already completed. Prune remaining dead wood from trees, shrubs, and vines, retaining natural shape. Continually remove all suckers on base of trees.

MAY: WEEKS 1, 2

TURF

Mowing shall continue once a week. During this period, it is important to note the soil moisture. Grasses may have been actively growing for about two and one-half (2 1/2) months, and need to be watered thoroughly.

TREES, SHRUBS, AND VINES

Inspect evergreens for mites and borers and spray as required. Inspect plants for scale insects and spray as required. Inspect flowering trees for powdery mildew and apply fungicide as required. Apply herbicide to shrub beds as required, using the same materials as in early spring. Weed beds as required. Water established trees at a rate of two (2") inches per week.

MAY: WEEKS 3, 4

TURF

Mow as required. Second application of fertilizer (Microlife Humates 0-0-4) shall be applied at manufacturer's maximum recommended rate. Water thoroughly after applying fertilizer. Mow first; then fertilize. Particular attention shall be directed to the amount of water applied to turf.

TREES, SHRUBS, AND VINES

Continue to check plants for pests and control as required. Water any established plants as needed. Pruning shall cease until Fall. Apply fertilizer to acid loving plants again.

JUNE: WEEKS 1, 2, 3, 4

Mulching trees, shrubs, groundcovers and seasonal color.

NATIVE GRASSES

Native grasses and love grass shall be mowed.

TURF

Mowing shall continue once per week. As the temperature rises, the mower should be raised one-half (1/2") inch to one (1") inch higher to maintain a good thick stand of grass. Inspect lawn for disease and inspect pests; apply fungicide only if necessary. Be alert for brown patch,

Bermuda decline and chinch bugs in Bermuda sod. Watch Bermuda for bare spots and underwatered areas.

TREES, SHRUBS, AND VINES

Maintain adequate moisture for newly planted trees, shrubs, and vines. Water any established plants as needed. Do not fertilize any wood plants until cooler weather. Continue to check plants for pests and control as required. Weed beds as required.

JULY: WEEKS 1, 2, 3, 4

TURF

Mow weekly, maintain previous months height. Avoid watering in the middle of the day. Check turf for disease again, especially chinch bugs. Third application of fertilizer (Microlife Hybrid 20-0-5) should be applied at manufacturer's maximum recommended rate. Apply recommended controls as necessary.

TREES, SHRUBS, AND VINES

Maintain adequate moisture for newly planted trees, shrubs, and vines. Water any established plants as needed. Do not fertilize any woody plants until cooler weather. Continue to check plants for pests and control as required. Weed beds as required.

AUGUST: WEEKS 1, 2, 3, 4

TURF

Mow weekly. Continue to irrigate as needed to keep turf from being stressed by lack of water. Inspect lawn for diseases. Apply necessary chemicals if needed; use caution.

TREES, SHRUBS, AND VINES

Continue to check trees, shrubs, and vines for adequate moisture around rootballs. No pruning shall be done during this period. Check all trees, shrubs, and vines for possible disease and insects, spray if necessary. Second application of fertilizer should be spread at manufacturer's maximum recommended rate.

SEPTEMBER: WEEKS 1, 2

TURF

Mow weekly. At this time lower mower to one and one-quarter (1 1/4") inches to one and one-half (1 1/2") inches. Irrigate as needed.

TREES, SHRUBS, AND VINES

Maintain adequate moisture for newly planted trees, shrubs, and vines. Water any established plants as needed. Root feed trees again. Acid type fertilizer and iron should be applied to trees, shrubs, and vines.

SEPTEMBER: WEEKS 3, 4

TURF

Mow weekly. Watch turf for diseases, apply chemicals as required.

TREES, SHRUBS, AND VINES

Maintain adequate soil moisture for all trees, shrubs, and vines. Prune only if necessary. Continue to check for any pests or disease, apply chemicals as required.

OCTOBER: WEEKS 1, 2, 3, 4

TURF

Mow weeks 1, 2 and 4. Watering can be reduced at this time. Continue to check for diseases. Fourth application of fertilizer (MicroLife 6-2-4) shall be applied at manufacturer's maximum recommended rate. Mow first; then fertilize. Water thoroughly after applying fertilizer. Turf should be thick and healthy for winter months. Overseed with annual rye grass at the rate of four (4) pounds per 1,000 square feet (only if requested by the Owner).

TREES, SHRUBS, AND VINES

Check trees for proper fertilization. Apply necessary elements, if inadequate. Pruning can be started lightly at this time. Weed beds as required. A two (2") inch layer of mulch shall be added on top of existing mulch.

NOVEMBER: WEEKS 1, 2, 3, 4

TURF

Mow weeks 2 and 4. Water less at this time.

TREES, SHRUBS, AND VINES

Examine plants for pests and spray as required. Do not use pesticides unless necessary. Weed beds as required.

DECEMBER: WEEKS 1, 2, 3, 4

NATIVE GRASSES

Native grasses and love grass shall be mowed.

TURF

Last mowing shall be performed during first 2nd week of month. Rake leaves as required.

TREES, SHRUBS, AND VINES

Remove leaves from beds. Weed beds as required. Check plants for diseases, spray as required.

END OF SECTION 32 94 00